# EDISON
## Electric Institute
# BULLETIN

**DECEMBER, 1935**

# STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

*Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry*

## DURING THE MONTH OF OCTOBER (*Preliminary*)

| | 1935 | 1934 | % |
|---|---|---|---|
| **Kilowatt-hours Generated* (net)** | | | |
| By Fuel | 5,680,704,000 | 4,863,362,000 | +16.8 |
| By Water Power | 2,595,117,000 | 2,457,204,000 | + 5.6 |
| Total Kilowatt-hours Generated | 8,275,821,000 | 7,320,566,000 | +13.0 |
| **Additions to Supply** | | | |
| Energy Purchased from Other Sources | 174,694,000 | 159,990,000 | + 9.2 |
| Net International Imports | 91,223,000 | 73,469,000 | +24.2 |
| Total | 265,917,000 | 233,459,000 | +13.9 |
| **Deductions from Supply** | | | |
| Energy used in Electric Railway Departments | 44,854,000 | 50,194,000 | −10.6 |
| Energy used in Electric and Other Departments | 108,389,000 | 118,909,000 | − 8.8 |
| Total | 153,243,000 | 169,103,000 | − 9.4 |
| **Total Energy for Distribution** | **8,388,495,000** | **7,384,922,000** | **+13.6** |
| **Energy Lost in Transmission, Distribution, Etc.** | **1,565,053,000** | **1,397,138,000** | **+12.0** |
| **Kilowatt-hours Sold to Ultimate Consumers** | **6,823,442,000** | **5,987,784,000** | **+14.0** |
| **Sales to Ultimate Consumers (kw-hrs)** | | | |
| Domestic Service | 1,186,018,000 | 1,081,444,000 | + 9.7 |
| Commercial—Small Light and Power (Retail) | 1,220,241,000 | 1,112,155,000 | + 9.7 |
| Commercial—Large Light and Power (Wholesale) | 3,726,353,000 | 3,141,751,000 | +18.6 |
| Municipal Street Lighting | 206,917,000 | 193,674,000 | + 6.8 |
| Railroads—Street and Interurban | 360,009,000 | 352,788,000 | + 2.0 |
| Railroads—Electrified Steam | 72,932,000 | 59,199,000 | +23.2 |
| Municipal and Miscellaneous | 50,972,000 | 46,773,000 | + 9.0 |
| Total Sales to Ultimate Consumers | 6,823,442,000 | 5,987,784,000 | +14.0 |
| Total Revenue from Ultimate Consumers | $162,788,900 | $155,811,500 | + 4.5 |

## DURING TWELVE MONTHS ENDING OCTOBER 31st

| | | | |
|---|---|---|---|
| **Kilowatt-hours Generated* (net)** | | | |
| By Fuel | 54,239,222,000 | 53,216,434,000 | + 1.9 |
| By Water Power | 36,101,268,000 | 30,370,640,000 | +18.9 |
| Total Kilowatt-hours Generated | 90,340,490,000 | 83,587,074,000 | + 8.1 |
| Purchased Energy (net) | 3,014,974,000 | 3,131,732,000 | − 3.7 |
| Energy Used in Electric Railway and Other Departments | 1,954,521,000 | 2,013,038,000 | − 2.9 |
| **Total Energy for Distribution** | **91,400,943,000** | **84,705,768,000** | **+ 7.9** |
| **Energy Lost in Transmission, Distribution, Etc.** | **15,686,443,000** | **14,632,890,000** | **+ 7.2** |
| **Kilowatt-hours Sold to Ultimate Consumers** | **75,714,500,000** | **70,072,878,000** | **+ 8.1** |
| **Total Revenue from Ultimate Consumers** | **$1,902,536,000** | **$1,822,895,600** | **+ 4.4** |
| **Important Factors** | | | |
| Percent of Energy Generated by Waterpower | 40.0% | 36.3% | |
| Average Pounds of Coal per Kilowatt-hour | 1.44# | 1.45# | |
| **Domestic Service (Residential Use)** | | | |
| Average Annual Consumption per Customer (kw-hr) | 663 | 626 | + 5.9 |
| Average Revenue per kw-hr (Cents) | 5.09¢ | 5.32¢ | − 4.3 |
| Average Monthly Bill per Domestic Customer | $2.81 | $2.78 | + 1.1 |

## BASIC INFORMATION AS OF OCTOBER 31st

| | | |
|---|---|---|
| **Generating Capacity (kw)**—Steam | 23,718,500 | 23,800,100 |
| —Waterpower | 8,962,200 | 9,006,400 |
| —Internal Combustion | 499,500 | 468,100 |
| Total Generating Capacity in Kilowatts | 33,180,200 | 33,274,600 |
| **Number of Customers** | | |
| Farms in Eastern Area (Included with Domestic) | (563,263) | (517,332) |
| Farms in Western Area (Included with Commercial—Large) | (216,147) | (209,798) |
| Domestic Service | 20,955,421 | 20,441,774 |
| Commercial—Small Light and Power | 3,780,127 | 3,724,998 |
| Commercial—Large Light and Power | 512,564 | 530,976 |
| Other Ultimate Consumers | 68,158 | 69,507 |
| Total Ultimate Consumers | 25,316,270 | 24,767,255 |

* By courtesy of the U. S. Geological Survey with deductions for certain plants not considered Electric Light and Power Enterprises.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume III DECEMBER, 1935 No. 12

# Power Aspects of Federally-Operated Reclamation Projects

**By W. D. Ketchum**

IN VIEW of the announced policy of the present Administration to "set up around the country sound publicly-owned utilities as yardsticks," and in view of the further fact that "the subject of power has become such a live one that the President has created, in the Public Works Administration, a Power Policy Committee," the personnel of which includes Hon. Harold L. Ickes, Secretary of the Interior, as chairman; Morris L. Cooke, Rural Electrification Administrator; Robert E. Healy, of the Federal Securities Commission; David E. Lilienthal, director of Tennessee Valley Authority; and Frank R. McNinch, chairman of the Federal Power Commission, which Committee has been "studying the whole subject of power and what the Government's position relative thereto should be," it may be interesting to inquire to what extent the Bureau of Reclamation has heretofore committed itself to entry into the field of commercial utility operation in connection with its reclamation projects.

The present Administration has definitely announced a policy which seeks to commit the Federal Government to an extensive program of commercial utility operation, in connection with a number of large hydro-electric generating plants now under construction. This policy is not supported by the past practices of the Bureau of Reclamation. This Bureau, although it has custody of a number of Government power plants, some of which it has been operating for years, has never adopted a definite "power policy." As recently as March, 1935, an editorial appeared in *The Reclamation Era*, a publication of the Bureau, containing the following statement:

"A uniform policy with respect to development and disposal of hydro-electric power on Federal reclamation projects should be established by legislation."

The same editorial contained the statement that:

"A bill has been introduced in this session of Congress designed to declare a policy with respect to the distribution of power revenues on Federal reclamation projects, and for other purposes."

Noting that the Bureau of Reclamation has had no fixed policy, and that Congress has not by law established a policy, it is interesting to note what has been done in the absence of a policy.

Historically, these developments are entirely unlike the present power program. Power development was originally undertaken on every one of these reclamation projects for one or more of the following purposes, viz., to supply power for the construction of the canals, dams, tunnels, and other works constituting the reclamation facilities, to supply power for irrigation or drainage pumping, and to supply power and lights for the operation of the gates and valves at the dams, and the camps which house the attendants who operate these facilities.

In the early days of reclamation work, power plants were constructed in connection with the projects only as a means of supplying power for construction purposes, thereby to reduce the cost of construction. Later reclamation projects are, in general, somewhat more difficult projects from the standpoint of irrigation than the earlier ones, and frequently required the pumping method rather than the gravity method of putting the water on the land to be irrigated. Several plants were constructed primarily to supply power for pumping. Typical of the first class may be cited the Boise River plant, the Lingle plant, Pilot Butte and Shoshone, each of which was built to supply power for the construction or excavation work necessary for irrigation. The Black Canyon, Minidoka, Siphon Drop and Prosser plants were built in order to supply power for irrigation or drainage pumping. The Elephant Butte plant is very small, its only purpose being to supply lights and power for the operation of the gates and valves at the dam and for the camp at the dam. Thus, power was initially developed on each of these projects to supply construction needs, pumping needs, or lights and power at the dam. In other words, no power was developed on any of these projects until there was an actual, legitimate need for power.

These plants represent no punitive expedition against the utilities, nor were they conceived as regulatory instruments for the control of the rates of utilities. They have nothing in common with the "yardstick" theory of the present Administration. They were originally, and are to day, direct phases of a reclamation program.

As for the fiscal year, 1932, there were in operation on federal reclamation projects, 20 hydro-electric plants having a total installed capacity of 102,550 kw. The Reclamation Bureau has, however, consistently followed the practice of turning over its projects, power plants included, to water users associations when the financial position of those organizations became such as to insure the preservation of the investment by the government. As a result of this practice, the Reclamation Bureau had,

up to 1932, transferred 11 plants. The nine plants still operated by the Bureau in 1932 had a total installed generator capacity of only 31,500 kw.

In view of the practice of turning over these plants, it is reasonable to expect that these nine plants will eventually be transferred to non-federal agencies. It appears that insofar as concerns any individual project, administration by the Reclamation Bureau is temporary, pending ultimate transfer to the users of the irrigation water when they are able to assume the financial responsibility. It goes without saying that insofar as concerns the plants which have been transferred to water users associations, the government is not engaged in their operation, nor is it engaged in the distribution or sale of power therefrom. Thus the Commissioner of Reclamation reported in 1932 that eleven of these plants were operated directly by the water users.

The question of the extent to which the Reclamation Bureau is engaged in the commercial power business reduces itself, therefore, to an analysis of the circumstances surrounding the production and disposal of power at these nine plants, plus an additional plant, constructed recently, and now operated by the Bureau, namely:

Black Canyon and Boise River, on the Boise Project in Idaho.

Minidoka Plant, on the Minidoka Project, in Idaho. (There is another plant, American Falls, on this project, but it is operated only in case of emergency and has not operated since 1927, and is, therefore, omitted from this discussion; its installed capacity is only 540 kva.);

Guernsey and Lingle plants, on the North Platte Project, Nebraska-Wyoming;

Elephant Butte Plant, on the Rio Grande Project, in New Mexico-Texas;

Pilot Butte Plant, on the Riverton Project, in Wyoming;

Shoshone Plant, on the Shoshone Project, in Wyoming;

Siphon Drop Plant, on the Yuma Project, in California-Arizona;

Prosser Plant, on the Yakima-Kennewick Project, in Washington.

**Boise Project—*Black Canyon (10,000 kva) and Boise River (1,875 kva) Plants***

These plants are interconnected with the transmission system of Idaho Power Company, and their entire output is fed into the system of this company, except for that power which is transmitted by the Bureau to Arrowrock Dam for construction purposes. During the non-irrigation season, the power company pays the government a fixed monthly sum to cover plant operation, and receives the entire output of the plant (Black Canyon only, as Boise River is operated only to supplement Black Canyon, when needed), except for 1,000 kw which is reserved by the government for construction use. During the irrigating season the power company, by arrangement with the Bureau, delivers power to irrigation district customers and is compensated for such use of its facilities in energy during the non-irrigation season. No other customers are supplied with power from these plants.

The entire output of the Boise River plant will ultimately be required for pumping on the Hillcrest Division of the project, while the entire output of the Black Canyon plant will ultimately be required for pumping on the Payette Division.

**Minidoka Project — *Minidoka (10,000 kva) and American Falls (540 kva) Plants***

The American Falls plant was last operated in 1927 and is used only in emergencies. These plants are connected through government-owned transmission lines and are also interconnected with the transmission system of the Idaho Power Company. Some of the power output over and above that required for pumping purposes is sold to a number of towns and to mutual power companies serving rural districts on the Minidoka Project, and the remainder of such surplus power is sold to the Idaho Power Company under an interchange contract.

**North Platte Project—*Guernsey (6,000 kva) and Lingle (1,750 kva)***

These two plants are interconnected by a government-owned 33 kv line, which is also interconnected with the transmission system of Mountain States Power Company at Guernsey, and with that of the Western Public Service Company near Gering, Nebraska. Numerous towns, several irrigation organizations, and a few industrial customers are served by the Bureau of Reclamation from government lines. With the exception of the town of Wheatland, Wyoming, all of these customers are inside the boundary of the North Platte irrigation project. No retail customers are served by the Bureau.

**Rio Grande Project — *Elephant Butte (150 kva)***

The amount of installed capacity at this plant is negligible. It is used only to supply power and lights to the dam and camp. No energy is sold.

**Riverton Project — *Pilot Butte (2,000 kva)***

This plant was originally built to supply power for excavation of irrigation canals. The output is being sold to Mountain States Power Company. Under the terms of the contract with that company, the Bureau added a second unit in 1930. Today, the Bureau delivers power to Mountain States Power Company at the edge of the irrigation project, and also at Morton, inside the project, deliveries being made over lines belonging to the Bureau.

In addition to these lines, there is one more, originally built and operated for supplying power for irrigation excavation work which has since been completed. The latter line is now operated by the Bureau to serve the Argo Oil Company, a 1 kilowatt lighting customer located in the project area, about four miles from Pilot Butte, in an area which is unpopulated and which has no other source of electric service. This is the only direct customer other than Mountain States Power Company served from Pilot Butte.

**Shoshone Project — *Shoshone Plant (7,000 kva)***

In this case, like Riverton, additional capacity was added to the plant in order to make available more power for the Mountain States Power Company, which has a policy of allowing its load growth to be met by increases in the capacity of the plants of the Bureau wherever possible, rather than by the expansion of its own generating plants. The Bureau owns and operates 6.5 miles of line from the plant to Cody, Wyoming, the Cody substation, and an intermediate substation between the plant and Cody, as well as the plant itself. It owns and leases to Mountain States Power Company, which operates it, additional mileage of 33 kv line, connecting Cody to several nearby towns. Substations at Powell and Deaver are also owned by the Bureau and are leased to the Power Company. The line from Garland to Lovell was in part purchased by the Power Company from the Bureau.

Under an interchange agreement with Mountain States Power Company, the latter receives the surplus energy from the plant over and above the needs of the Bureau's own customers, which are as follows:

1. The Bureau supplies standby service to the municipal electric system at Cody.
2. It serves two cooperative distribution organizations, at least one of which is actually supplied by the Power Company for the account of the Bureau, over lines and through a substation which is owned by the Bureau, but which is leased to and

operated by Mountain States Power Company.

3. The intermediate substation between the plant and Cody, referred to above, serves a Hot Springs resort located in the Canyon below the plant in an unpopulated area having no alternative source of power supply. This is a 2 kilowatt lighting customer.

**Yakima-Kennewick Project** — *Prosser Plant (3,000 kva)*

The Reclamation Bureau owns this plant and operates it, as well as the step-up substation, and about one mile of 66 kv line through which the entire output of the plant is fed into the transmission system of the Pacific Power and Light Company system. Under the terms of the contract between this company and the Bureau, the company delivers government energy to several irrigation districts for the account of the government, receiving for this service a certain amount of energy during the non-irrigation season. Under the contract, the company must take all power produced at the Prosser Plant, over and above the requirements of the irrigation customers of the Bureau. However, it does not guarantee the company any power during the irrigation season.

**Yuma Project** — *Siphon Drop Plant (2,000 kva)*

Except for energy used by irrigation organizations, and employees of the Bureau, Southern Sierras Power Company and its subsidiary, Yuma Utilities, takes the output of this plant. Energy is delivered to these companies at the dam.

It thus appears that the Reclamation Bureau has no power policy, fixed either by law or by the Bureau itself. It also appears that less than half of the power plants on Federal reclamation projects are now being operated by the Reclamation Bureau. Of the total capacity of 102,550 kw on all the Federal reclamation projects in 1932, only 31,500 kw remained in operation by the Bureau. This 31,500 kw of capacity is geographically scattered over the entire west, among nine plants. These plants are operated by the Bureau as a strictly related phase of its reclamation program; there is no utility operation, no control of resale rates, no competitive duplication and in no instance where any sale or exchange of power is made is there anyone who could make complaint.

## HOW THE FOREMAN CAN PREVENT WASTE FROM ACCIDENTS

*Twelfth of a series of articles sponsored by the Accident Prevention Committee, E.E.I.*
W. A. BUCHANAN, *Chairman*

1. Recognize Accident Prevention as a part of production and accept whole-heartedly his responsibility in accordance thereto.
2. Handle the Accident Prevention problems of his group personally.
3. Accept without alibi his responsibility for accidents occurring under his supervision.
4. Look to the Accident and Fire Prevention Department for assistance but not to prevent the accident.
5. Set a good example at all times.
6. Know all company safety regulations and instructions applicable to those under his supervision and see that each receives these instructions from him as the company's agent.
7. Train all employees under his supervision in Safe practices.
8. Train all employees in safe and correct operations. "Tell him, show him, test him and check him."
9. Use discipline for violation of safety instructions on same basis as violation of instructions in other features of operations.
10. Make sure that employees understand safety and other operating regulations and expect them to follow them.
11. Show sincere interest in injured or sick employees.
12. Study records and analyze accidents, then use the information gained.
13. See that accident reports are made correctly and promptly and sent through the proper channels.
14. Study the hiring and placement of men according to their physical and mental suitability and the hazards of the job.
15. Install mechanical safeguards where necessary and keep them in repair.
16. Do not allow men to work with guards out of place.
17. Know what constitutes an accident hazard and correct it before the accident occurs.
18. Make regular and conscientious inspections.
19. Do not permit men to work without necessary protective devices, such as goggles, gas masks, welding helmets, safety belts, etc.
20. Display "Danger" and "No Smoking" signs at proper places and see that they are clean and legible.
21. See that good housekeeping is maintained.
22. See that company vehicle operators are trained in correct driving and accept their full responsibilities to themselves, the public, and the company.
23. See that every point of contact with the public is guarded against errors that would cause an injury to the public or damage to public property.
24. Study fire prevention, inspect against fires and keep fire fighting equipment in good condition and properly placed at all times.
25. Be friendly but not familiar; firm but not "high-hat" and close in to a mutual understanding with employees under his supervision.

## RECENT E.E.I. PUBLICATIONS

### OIL AND GAS ENGINES—1934-1935

**E.E.I. Pub. C-8. A report of the Prime Movers Committee, Edison Electric Institute, 19 pages. Price 50c. to members and their employees; $1.25 to non-members in the U. S. A.; $1.35 to foreign countries.**

This report contains the following:

Diesel-Engine Progress and Trends: Diesel production, new developments, new installations in U.S.A. and Canada; installations in foreign countries.

Diesel Fuel Oil: tentative classification of fuel oil; testing.

International Electrotechnical Commission Work.

High Speed Engines: specifications, auxiliaries; mechanical-drive units; new radial engine; fuel and lubricating oil, maintenance costs.

Slow- and Medium-Speed Diesels: operating difficulties, operation and maintenance records; British experiences.

Miscellaneous Cost Data: engine costs, trend of energy costs.

Plant Operating Data: covering 63 engine units; maintenance costs; operating factors and outages.

Manufacturers' Statements.

### SYMBOLS FOR METERING DIAGRAMS

**E.E.I. Pub. C-10. A report of the Electrical Equipment Committee, Edison Electric Institute, 9 pages. Price 10c.**

Confusion has been caused in the past due to lack of uniformity in meter symbols, vector diagrams and conventions. As a guide to authors in the discussion of meter problems and the preparation

(*Continued on page* 482)

# The Facts About Low-Voltage Fatalities

**By Alexander Maxwell**
*Director of Engineering, Edison Electric Institute*

DURING the past year or two a grossly inaccurate statement has persistently appeared concerning the number of shock fatalities associated with house wiring. This statement runs to the effect that there occur annually some 700 shock fatalities or "electrocutions" and although it is not often explicitly so stated the plain inference from the context and the subject-matter is that these fatalities are associated with house wiring at ordinary utilization voltages. This misleading statement has been noticed frequently at meetings of electrical inspectors, in parts of the technical press and elsewhere among those concerned with electrical wiring.

Thus in a recent article* under the caption "Electrocutions" the following occurs: "One large insurance company gathered data on over 700 electrocutions in one year. A large percentage of these were in the home. The baby puts its finger into a screw receptacle. A person steps out of a bathtub . . . etc." The obvious purport of this as in other similar comments is that there are 700 fatalities annually more or less under the circumstances described. Whether by design or not, this has actually been the effect of the constant reiteration of this figure, for there are many persons interested, but not especially well informed, who apparently believe sincerely that there are about this number of low-voltage fatalities caused annually by ordinary house wiring and its appurtenances. Some of these men have actually been observed to indignantly reject as a callous attempt to minimize the facts any suggestion that the number may be less or the causes different than those they have been led to believe are true. This figure of 700 fatalities annually is wholly erroneous for low voltages, overstating the actual figure by about 800 per cent. The true statement is that there are about 75 or 80 electrical fatalities per annum in the entire United States from contact with ordinary light and power circuits at 150 volts to ground or less; that about 25 per cent of these, or 18 to 20 per annum, occur in the home, and that practically none of these in the home or elsewhere have any important or significant relation to the fixed wiring and fixtures in the premises. The facts are as follows.

The total number of electrical fatalities at *all voltages* and under *all conditions,* but excluding lightning, as reported by the U. S. Public Health Service for the total registration area of the United States which comprises about 96 per cent of the total population, is 811 average for the last three years available, 1930 to 1932 inclusive. For the individual years the figures run as follows:

| | |
|---|---|
| 1930 | 987 |
| 1931 | 780 |
| 1932 | 667 |

This annual total includes all high tension cases, both to plant or construction employees and the public, all electric railway cases, both overhead trolley and third-rail, and all cases occurring in mines or other industrial and construction works at the higher utilization voltages. Even the slightest knowledge of the prevalence of these other classes of cases will lead to a realization that the low-voltage cases could not possibly reach the figure of 700 per annum or anything like this.

From an examination of the vital statistics records in certain states where it has been possible to analyze them completely, it appears that the low-voltage cases as defined above constitute about 8 per cent of the total and if this ratio held consistently for the entire registration area it would account for approximately 65 low-voltage cases per annum. As will be shown later, this is a fair approximation of the total, but with the possibility that it may be somewhat low due to the fact that the ratio of low-voltage cases to the total established for a very small number of states may not hold for all.

Fortunately a much more reliable statistical record of this particular aspect of electrical fatalities is available in work initiated by the former N.E.L.A. and carried on by the E.E.I., since its organization. This investigation has consisted in the procurement through the member companies of these organizations of a complete survey of electrical accidents for specified territorial areas and known populations where all of the significant circumstances surrounding the cases can be and have been investigated. The record so produced may tend to give a result slightly higher than the true figure because doubtful cases have been resolved in favor of the fact of a low-voltage occurrence, but this error if present at all is small.

It is expected that this work when fully developed will be made the subject of a technical report, and as such it will represent an analysis of a satisfactory statistical sample comprising approximately one-third of the population of the country. It may be stated for the present that this investigation quite definitely establishes a statistical rate of 0.8 low-voltage fatality per million of population per annum. If it is assumed therefore that 100 million of the total population of the United States have access to electric circuits, this rate would produce a total of 80 per annum; but since it is improbable that the number of people living or working in electrified areas is quite as great as this, the number may be somewhat less. In a similar manner it has been found that the number of these cases occurring in homes, that is to say, the cases affecting the ordinary inhabitants of domestic premises in relation to the normal and customary electrical equipment of the premises is about 0.2 per million of population per annum, or, as stated above, 20 per annum or less for the entire United States.

Although an adequate discussion of the circumstances under which these cases occurred would greatly exceed the possible limits of this article, it may be stated and in due course it will be shown that with occasional exceptions none of these accidents were conditioned upon the wiring of the premises in the sense that they would not have occurred if the wiring had been in a different condition. Specifically these electrical accidents are not, in general, due to defects in wiring. The reason for this is that an overwhelming majority of the cases are due to improvised equipment made by the victims themselves, to the ignorant or wrongful misapplication of equipment which is standard and safe for its intended purpose, or to erratic combinations of circumstances that can hardly

(*Continued on page* 488)

*Electrical Contracting, December, 1935, page 17.

# Farm Electrification

## Rates Must Be Sound if Rural Electrification Is to Be Built on a Permanent Basis

By G. C. Neff

*President, Wisconsin Power and Light Company*

Excerpts from a paper presented before the Indiana Electric Association

IN the United States farm electrification has been guided by the joint studies, suggestions, and recommendations of cooperative groups that were interested not only in the manufacture and distribution of electric power but also in the economical and efficient use of such power by the farmers. I believe that fewer mistakes have been made to date in the development of the farm electric business than would have been made if either the utility companies or the farm organizations had acted independently of each other and had attempted to develop electric service alone. Through the cooperative studies, the utility people got first-hand information on the problems of the farmers and the farmer representatives learned something about utility problems. The result was a better mutual understanding and respect which is so necessary to the efficient solution of reciprocal problems of this kind. I sincerely hope that the cooperation that has existed to date will not only be continued but will be made more effective and more complete.

Through these cooperative activities during the past 10 years, the idea has been firmly impressed upon the minds of the utility people that the cost of farm lines must be reduced so that the cost of electric service to the farmers can be made as low as possible. At the same time the representatives of the cooperating farm groups learned that it is not economical in the long run to put up a line that is too flimsy and cheap. They recognize that satisfactory service cannot be obtained from such a line. As a result there has been developed a type of line which has a reasonably long life and from which satisfactory service can be obtained and yet is low in cost. By 1930 most of the companies who originally built farm lines very much after the standard of city lines had put their engineers to work and had designed farm lines to fit the conditions imposed by farm service.

MR. NEFF

With the very valuable assistance of the agricultural colleges and experiment stations throughout the country, these cooperative studies developed many new types of farm machinery designed particularly for electric drive. This equipment was developed with the idea of rendering satisfactory service to the farmers and at the same time making it possible for the utilities to supply the necessary power at low cost.

The results from all these cooperative activities have, in my opinion, been of great benefit to the development of the farm electric business. The investment in farm distribution lines has been held down very materially and there have been tremendous savings in the cost of electric equipment to the farmers without in any way sacrificing the quality of the service. This is the reason I say that the development to date has been made on a sound basis and a good foundation has been laid for future expansion.

It is estimated that utilities have already spent something over 200 million dollars in the building of farm lines and the farm customers have spent a like amount for wiring their places and for equipment to make use of electric service. Altogether there has been invested on both sides approximately one-half billion dollars. This shows the size of this job known as rural electrification.

It is the hope and wish of every one connected with the development of rural electrification that lines will be built as rapidly as practicable to extend this service to additional farms. But it is also the hope and wish of the people who have been most closely associated with this movement that it proceed on the sane, orderly, and sound basis on which it has reached its present status. It will be most disastrous if some wishful thinking leads this development into channels where serious mistakes will be made which will be costly, not only to those who make the utility investment but to the farm users as well.

Any business that cannot eventually carry itself but must be subsidized is sooner or later going to fall. It is my opinion that the farm electric business can be built so that it will carry itself, that it need not be continually subsidized, and that it can be made a permanent business. To bring about this condition, all connected with the development must submerge their wishful thinking to plain straight thinking based on facts.

We know that in the Middle West the average farm line serves somewhere between 3 and 4 customers a mile. We also know that the voltage necessary to render satisfactory service over a wide area in this part of the country is 6900 volts. We know that if the farm load is to be developed up to a satisfactory point, it will, on the average, require a 3 kw transformer for each customer. We know that a typical mile of farm line including transformers, all the necessary protective devices, meters, service drops, etc., if built so as to give reason-

ably long life and satisfactory service, will cost from $1,200 to $1,400, depending on local conditions. With these facts before us, it is a simple matter to determine what the charges for farm service must be if the utility company is to earn a reasonable return on the money it has invested to serve farmers.

In determining these charges, I believe the utility should base them upon an average consumption somewhat higher than the present average because we all know that the development of farm load has only begun and that the average consumption must be built up during the next 10 years to a point very much higher than it is now. This means that the companies which follow this procedure would, for the present, earn a lower rate of return during the development period, but as the use of energy increased, they would earn a reasonable return on their farm line investment. Furthermore, in determining rural charges, I believe that farm business should be given the benefit of the doubt on all points open to reasonable question. In other words, the costs charged against farm line operation should be held as low as they reasonably can be.

I do not believe that the farmer himself wants the service supplied to him on any other basis than the one just outlined. He does not want his friends in the city to pay part of his electric bills—all he wants is to know that the bill is fair and reasonable and that he is getting enough out of the service so that he can afford to pay a fair and reasonable bill. The various state regulatory commissions are in a position to determine whether the rates charged are fair and reasonable.

There is some talk these days of disregarding the facts which I have just briefly enumerated and of making rates to farm customers lower than will yield a fair return when the business is fully developed. That means that the city people would have to pay a part of the farm electric bills. In my opinion this is unsound, dangerous, and will result in disaster to the utility companies and to the farm customers as well. The urban customers do not want to pay for farm electrification any more than the farmers want them to pay their bills. Any utility that makes such a set-up will find that as the farm business increases and the subsidy paid by the city customer increases, the city people will soon be talking of their own municipal plant for which they will pay only the cost of their own service without carrying a part of the farm business. Before very many cities on any utility system put in municipal plants, the business of that utility will be jeopardized and it may no longer be able to continue serving farms at the "below cost" rates. In fact, the loss of the city business will increase the actual cost of serving the farmers, and a condition may be created under which the farmer will not be able to pay the cost of serving him and will be forced to give up electric service altogether. For the most part, municipal utilities are not much interested in extending service into the country. The net result of the whole thing can easily be that the utility would be bankrupt and service to farmers would be discontinued as a result of this procedure. This sort of development is unsound and is bound to lead to trouble. For that reason I hope that no utility company will set up rate schedules under which farmers will be served at less than cost.

On the other hand, I think a utility must recognize the fact that it cannot expect to get a full return from the farm business during the present development stage. It must be willing to take a small return at this stage and aggressively build up the business so that it will in time pay a full return on the investment. There is nothing strange or novel in this policy and procedure. The same program has been followed in the development of the city business and of the little town business.

Prior to the depression, the utility companies were building a great number of farm lines and farm service was being extended quite rapidly. With the coming of the depression, they could not secure the funds to continue this development at the same pace. At the same time the farmers were short of the money needed to wire farm buildings and buy utilization equipment. Therefore, the depression very greatly slowed up the progress of rural electrification in this country, although each year the number of farmers receiving electric service continued to increase. Now, the creation of the Rural Electric Administration at Washington, with a hundred million dollars to be used in the building of farm lines, has brought a new force into this rural electrification movement.

If an appreciable part of the R.E.A. hundred million dollars can be loaned to utility companies to finance the building of new farm lines, the movement should now go ahead at the same rate or even more rapidly than it did immediately before the depression. The utility companies are the logical people to build these lines because they have already built about 95 per cent of all the farm lines in this country. Their men are trained to build and operate electric lines. They are now doing business in practically every city and village in the country and can get under way very rapidly as soon as funds are made available. The R.E.A. says it is willing to loan money to any one who will build satisfactory farm lines and charge reasonable rates, on the basis of 3 per cent interest on the unpaid portion of the loan and with annual amortization payments over a period of 20 years. I believe that most utility companies can afford to borrow money on this basis for the building of farm lines into any territory where such lines are justified. While some of the companies serving large communities may have sufficient money to finance all farm lines in their territory, I am quite sure that many companies are not able to do this and in order to get into a farm building program of any magnitude will need to borrow money from some source. As a matter of fact, the big part of the farm line building job will have to be done by those companies that are rural in character and, as a rule, short of cash. It is in the territory served by those companies that a very large part of the unserved farmers live. It seems to me that every utility company which has good farming territory not yet supplied with electric service should immediately make the necessary surveys to determine where lines should be built. Then they should make application to the R.E.A. for necessary loans to finance those lines wherever the farmers desire service. Such a program will not only further the development of rural electrification but will also stimulate business and create jobs for men, which in itself is highly desirable.

I earnestly recommend that no contract for a loan be made which contains an agreement to build lines that are inadequate to furnish satisfactory service or are of such character that they will not be reasonably long lived. I further recommend that no rates be agreed to which are below the standards I have tried to set up in this paper. The rates must be sound if rural electrification is to be built on a permanent basis.

# Some Present-Day Problems of Industrial Power Sales

**By George E. Whitwell**
*Vice-President, Philadelphia Electric Company*

An address before Pennsylvania Electric Association, Bedford Springs, Pa., September 5.

IT has been my opportunity to observe the problems of industrial power in their relationship to the problems of merchandising, of residence load-building, of retail sales, of advertising, of lighting, and of a great variety of other applications of electricity. Perhaps because of this I can start off by assigning to industrial power the place that I think it should hold among all of the selling activities of an electric utility; namely, the one that it had held for years before business depression tended, in some instances, to minimize its importance and thrust other selling activities more into the foreground. The place of industrial power sales should be second to none!

Let us divide utility selling into the five sub-divisions of (1) residential—with or without merchandising, (2) lighting of all kinds, (3) retail or small commercial, or sales to those non-residential customers, including rural, whose connected load may be set at some such figure as 25 hp. and less, (4) industrial power, and (5) miscellaneous, including municipal, railway, and other utility. It is my opinion that right now, throughout the last five depression years and during the dozen or so years preceding them, any utility is making, and has made, a serious mistake if it permits or has permitted any condition to come about that has forced its industrial power sales off an equal plane with any of the other four divisions of utility selling.

It has been said, very wisely and truthfully, that no community can be greater or better or stronger than the utility serving it, and that, conversely, no utility can rise materially above its community or communities. Few indeed are the villages, towns or cities that can even survive, much less prosper, without businesses that require the use of industrial power. I know of no community that would not be better off if it could attract and support additional industries and medium-to-large size commercial enterprises.

Industries maintain and attract residence and small commercial users of electricity. Without industries, encouraged and helped by the power salesmen and served under soundly designed and economically competitive rates, there would be few payrolls to provide the money for bills for residence electricity.

No matter how much the rates for small users are reduced or how attractive—even unsoundly so—the cost of electricity may become for residence and small commercial users of electricity, there must be, among all of these users, the ability to pay not only for electricity bills rendered, but also for electricity-consuming devices. Let us, then, give heed before we increase our selling activities among residence and small commercial customers, or offer price inducements to them, whether of current, or of appliances, or of equipment, to an extent that will preclude similar activity and sound price inducements to present and future users of industrial power.

### Three Main Problems Today

What are the main problems today surrounding the holding and increasing of industrial power business? To me, there are three which must be understood, faced and met by every utility. They are: (1) the present condition of the market; (2) the existence of some uneconomic and non-competitive industrial rates; and (3) the extreme difficulty of correction if too great unbalance is created between industrial rates on the one hand and rates to any or all other classes of service on the other.

### Condition of the Market

What is the condition of the market? It will vary, of course, in different localities, but, by and large, every utility finds the following existing circumstances:

*First*—There is general stagnation in the expansion of present plants and in the building of new ones.

*Second*—Such isolated plant load as remains is not readily obtainable for the central station under present conditions, so great has been the past activity in shutting down those isolated plants which could economically change to purchased power.

*Third*—There are persistent demands for operating economies, wherever possible, within the organizations of the industries themselves, thus directly bringing under careful scrutiny the power costs in all industrial and large commercial establishments.

*Fourth*—Uncertainty, amounting in some cases to irritability, exists among the operating people in industry. This has been due to pressure of labor problems, taxation, and Government interference, and has raised financial questions of which the utility has been sometimes the unfortunate, frequently the unknowing, and always the unwilling, beneficiary.

*Fifth*—The activity of competitors is increasing during a period when some industries have more cash available for the purchase of new equipment. Coincidentally, therefore, the electric utility today must be more than ever cognizant of Diesel and steam engines, and of gas, oil and other fuels which bring with them improvement in equipment, intensive combing of territory by their salesmen, and new and attractive financing methods.

*Sixth*—We have the so-called rate experts, many of them born in our own industry, some of them sincere and capable, a few of them promoting that which is little short of a racket, and all of them needing a living and trying to get it.

*Seventh*—There exists the danger to industrial business of the effect of political pressure on other parts of our business, particularly residential and small commercial, that has begun to, and, unless checked, will increasingly tend to destroy the natural, economic balance that heretofore has existed between the revenues that we have derived from the five classes of customers which I have already mentioned.

These market conditions are present. While briefly sketched, they are important, may be serious and deserve as much attention from utility executives as is given to any other single phase of our operations. Of them, I will discuss further only the fourth, which is the present uncertainty within the customer's organization, the fifth, which is competition and which falls so naturally into the problem of the existence of some economic and non-competitive industrial rates, and the seventh, which is only another way of expressing the third problem, namely, the balance that should

be maintained between various classes of business and the difficulty that will attend any unbalance that may be permitted at this time to creep into rate structures and revenues.

**Uncertainty Within Customers' Organizations**

Depression years have brought about some conditions within the customers' organizations and upon customers' premises that merit a great deal more than passing attention by utilities. Under the pressure of unprofitable operation, or of the necessity for conserving cash, many high-tension customers' substations have been built or maintained under such competitive conditions that there are too many instances of second-hand or inadequate equipment and of deferred maintenance. Recent improvement in business has caused conditions of over-load on all kinds of electrical facilities owned by customers. Frequently these facilities were already in not too satisfactory a condition to meet even normal loads because of lack of maintenance during preceding years. Maintenance crews on customers' premises are at a minimum and have been for months. Operating men in industry have in many instances been so long denied requests for proper electrical replacements or new construction that their morale is somewhat weakened and their performance not up to the standard of former years. In some utility companies inspection service of industrial customers' equipment or of conditions where paralleling exists, has been curtailed in the interests of economy, thus only aggravating these other substandard conditions which industry itself has created. All of these circumstances tend to produce an inferior service which, though it results from conditions practically entirely the responsibility of the industries and within their control, reflects in many customers' minds upon the value and dependability of purchased power.

I urge that you make it a point to study your recent interruptions to industrial customers and compare them with the records of former years so that you may be able to determine their relative severity, regardless of whether their causes lay in defects in your own system or its operation, or whether they rested with the customer. It would even be valuable to institute investigations of the conditions existing in the electrical facilities on customers' premises so that corrections in customers' equipment, operation and maintenance may be recommended before serious issues confront the utilities' power salesmen.

**What of Decreasing Costs of Competition?**

Turning from this phase of our problem I want to call to your attention some of the improvements that have taken place over the last fifteen years in isolated plant equipment and in its cost of operation. My object is not to alarm. Unless I am very much mistaken, a study of the decreased costs of competition throughout Pennsylvania will not show, by and large, that these competitive costs are lower than central station service. Utilities' power rates have been going down, too. Nevertheless, I believe that if competing costs are compared directly with your individual industrial rates, you will be surprised to find how much of the wide margin which was in your favor fifteen years ago has disappeared.

At that time the industrial power plant was generally equipped with low-pressure boilers operating at 100 to 200 pounds, supplying steam to reciprocating engines discharging to the atmosphere. Efficiencies of both boilers and prime movers were low. Turbines of less than 1000 kw were too inefficient to be practical. In order for these plants to compete successfully with the utility, they had to utilize about 75 per cent of the steam necessary to produce the power.

Between 1920 and 1930, however, improvement in boiler efficiencies was brought about by many factors. Better stokers and methods of fuel preparation and of combustion, higher settings to allow more space for combustion and more exposure of heat transfer surfaces, super heaters, economizers, water walls and better water circulation, steel able to withstand the stresses due to higher temperatures and pressures, and greater knowledge of boiler operation at high pressures and ratings, all contributed to this improvement.

Similarly with turbines, better steel was made, designs of nozzles and blades improved, methods of steam extraction and pressure control were bettered, and condensing equipment was made much more efficient. Higher pressures could be utilized, which resulted in higher turbine efficiencies. Other electrical equipment, including generators, improved.

The net result of these improvements in boilers and turbines has been a reduction in over-all power operating costs of perhaps from 20 to 40 per cent. And this is not all. From 1920 to 1929 the unit cost of an industrial power plant decreased steadily and, with the depression, this decrease became precipitous, particularly where distress equipment was involved. While prices have now increased somewhat, customers' confidence and willingness to make commitments have also increased, so that within the past year there has been a tendency on the part of industrial customers to give serious consideration to installing their own power plants.

For a startling presentation I would suggest that you prepare a chart to graphically illustrate the trend. Use figures, as I have done, to compare the increment cost (including fixed charges) of generating electricity during the period 1921 to 1925 and during the year 1934; figures obtained by taking the difference between the cost of operating a complete isolated plant producing both power and steam, and the cost of operating a boiler plant for the supply of steam only. I have assumed that in the period 1921 to 1925 the low pressure process steam requirements were such that the by-product power generated by it was equivalent to 33 1/3 per cent of the total power requirement. The same total power and process steam loads were used in calculating the costs with a modern power plant.

Plot these decreases against a similar curve of decreases which customers have obtained with your power rates, and learn for yourselves the extent to which the margin which existed between purchased and generated power during the period 1921 to 1925 had disappeared during the year 1934. I believe that you will then understand why I have said to you that industrial power selling must not be removed from the same plane with the selling of other utility service. Furthermore, it must be made very certain that under stress of some immediate circumstance, neither discrimination nor unsound rates are permitted to creep into the industrial power picture.

**Maintain Balance Between Classes of Business**

The third problem, which I have mentioned, permits of very little further elaboration. It is one that, although somewhat intangible, is, in my opinion, of vital importance in that it may affect, not only the present, but the future for many years to come. Let us not disturb so greatly the natural economic balance between revenues from, and rate characteristics of, the various classes of our business that it may take months, or

even years, to bring back that proper relationship without which there cannot exist a rational development of our entire business. It is perfectly obvious that conditions exist today that make it very easy for any one of us to go so far in rate reductions and other concessions to residential and small commercial customers that there will result an inability to proceed soundly in meeting the competitive industrial situation. No one believes more firmly than I in the principle that justified lowering of rates of all kinds produces sufficient new business to show ultimate profit. Permit me merely to point out that this principle is just as true of industrial rates as of any other type.

### What To Do About It?

What can we do about this industrial power situation? I do not think I can tell you anything new. I am sure that I am not going to suggest anything drastic because the matter is not one of sufficient immediate seriousness to warrant it.

The methods of meeting the problem may be grouped under three general heads, each with subdivisions. The first is analysis, the second is market knowledge, and the third is sales methods.

### Analysis of Customer's Methods

By analysis I do not mean the generalities usually envisioned when one mentions market analysis. I mean, rather, the analysis of customer's methods in his entire procedure for producing his final product. It is essential that every utility company have, and continue to develop, intensive analyses in order to increase applications for electricity. From such analyses there results replacement of cumbersome methods, changing from which was perhaps previously considered to be without profit to either customer or utility. New and added applications of electric power for heating and melting appear. Unknown opportunities for the use of air conditioning blossom right before our eyes and both customer and we wonder why they were never thought of before. Added profitable use of light is sold without former realization of how valuable such increased illumination was to the customer. There are disclosed possible applications for electricity for which equipment is not yet even available, so that such applications can be called to the attention of the manufacturers and they, already in close contact with the utility, can become an equal beneficiary in new mutually profitable uses for electricity in industry.

### Knowledge of Market

I want to mention only three things in connection with knowledge of the market. The first is that we put ourselves into such a position that we can foresee market trends and developments sufficiently clearly so that our rate departments may be advised of desirable and proper rate changes before customers become irritated by obsolete or unnecessary tariff provisions. It is an easy thing to get into a tariff something presumably essential at the time of its introduction and then to forget all about removing it when conditions may have changed to such an extent that such provisions are not only no longer necessary for the utility but may have become a hardship upon the customer and a real deterrent in holding present business and in obtaining new and additional business. Isn't it a good idea to review, at regular intervals, the words that are in our rates, such review being conducted jointly by rate people, engineers, operating men, legal talent, sales representatives and others, so that we may be very sure that we are not unnecessarily handicapping ourselves in the light of present knowledge of our markets?

The market should be thoroughly and constantly studied in the light of the trend of competition. Only in this way can sales and rate departments know the needs of the situation at any particular time and meet these needs, so far as it is possible to do so, before competition gets a real foothold. *Business may be held at prices above competition. Once lost, it can only be regained by prices which go below competition.*

As a third suggestion in connection with markets, I am offering the maintaining of engineering knowledge of them through power plant and equipment testing on customers' premises. Only in this way can we be kept thoroughly abreast of competitive developments. Furthermore, such testing must be continually renewed if it is to be of value and tests must be made in such a way that each one shows a complete story from load to product, thus permitting it to be used for jobs other than the one for which it was made specifically.

### Sales Methods

Finally, we come to sales methods. Let me give you but four of the many ideas and practices that exist as methods of industrial power selling. I believe these four merit careful consideration:

*First*—There is the ever-present problem of the compensation of the industrial power salesmen. These men, to be of value, must have qualifications unique among all kinds of sales people. Essentially they are engineers with sales ability, or salesmen with engineering knowledge—a combination known to all of us as rare.

*Second*—Industrial power sales lend themselves particularly to direct-by-mail advertising, with immediate follow-up by utility and manufacturer salesmen. This advertising, to be most effective, I think, should be a cooperative effort between utilities and manufacturers. It should be directed at some specific power application, such as air-conditioning or industrial heating. Maximum use can be made of total available manpower if, in the immediate follow-up of such advertising, the utilities' power salesmen are used to separate good prospects from bad, and the cooperating manufacturers' industrial salesmen are used to convert the good prospects into purchasers of equipment and greater users of electricity. I do not believe that shotgun advertising and sales methods are of any value in the power field—the rifle is used to bring down big game.

*Third*—At times other than during the conduct of specific campaigns, such as those just mentioned, I think there should be complete and continuous contact between power salesmen and customers. It is easily conceivable that it is profitable for some customers to be contacted once every week. Stretching this to once every two weeks may prove to be very unwise economy. On the other hand, there are many industrial customers, the contacting of whom oftener than once in three months, in six months, or in twelve months, would be only an unnecessary waste of money and might even boomerang with unfortunate effects.

*Fourth*—There is the tremendous question of service, in its broadest sense, to the industrial customer. With the residential or small commercial customers it is possible, and even necessary, to regard them as a group, treat them as a group, and lay down definite rules for handling the great majority of their complaints and questions. So similar are their problems and uses that many, if not all, residence rates are block rates and some small commercial rates are of this type. Even so, it is the desire of most utilities to give to these customers as much individualized, personalized service as possible. How much more necessary is this with the industrial power customer, the individuality of whose problem we have already recognized through the almost universal acceptance of the demand-type of rate which is applied individually to each customer.

I submit that the maintenance of market acceptance among industrial power customers will only reach maximum success through flexible, reasonable handling of complaints, service troubles, and abnormal situations. Sales resistance becomes excessive in an industrial market which has been antagonized by an attempt to substitute rules for reason. I believe that the only intelligent policy to be followed by a utility in dealing

At the meeting of the Edison Electric Institute Industrial Power and Heating Sub-Committee, held on December 2nd and 3rd, tentative plans were outlined for a two-day conference in Chicago during March *devoted exclusively to power sales problems.* Present arrangements are that the Power Sales Conference will immediately precede the regular Sales Conference which has been held annually for several years in Chicago.

with this type of customer is one which, while it protects the company, at the same time meets just and reasonable market contingencies.

**Conclusion**

In conclusion, it seems to me that there are signs of continued opportunity, for some time to come, for power companies to obtain appreciable increase in revenue from industrial power customers. There are no indications at this time that the favorable trend established during the first seven months of this year will not be maintained for at least the balance of the year. All of the basic economic factors which make for a return of good business are present, with the exception of sound money and a reasonable labor market. Demands for replacement have piled up, money is cheap, unwise investments have been largely liquidated, and people generally are ready to spend money for consumer goods.

The pressure of these factors is so great that we have already had, both in 1934, and at present, a thrust upward in business activity. Unfortunately, in 1934, this thrust dissipated itself against the labor situation and the refusal to risk investment on a large scale in the face of the attitude of the Government toward money and its disposition toward despotic interference with business. The present upturn will have the same ultimate fate unless these obstacles are removed.

Nevertheless, industrial activity is greater at present even if, perhaps, it is not so great as in the inflation boom of 1933 and the upturn in 1934. It may go higher than 1934 and last longer.

(*Continued on page* 486)

# ELECTRIC REFRIGERATOR SALES

*(Household Models Only)*

MONTH OF OCTOBER AND FIRST TEN MONTHS OF 1935—1934

| | Month of October 1935 | Month of October 1934 | Month of September 1935 | First Ten Months 1935 | First Ten Months 1934 |
|---|---|---|---|---|---|
| *Total United States* | *43,706* | *29,567* | *53,622* | *1,467,189* | *1,272,331* |
| Maine | 90 | 113 | 207 | 7,470 | 6,611 |
| New Hampshire | 76 | 77 | 263 | 5,411 | 4,526 |
| Vermont | 46 | 49 | 118 | 3,358 | 2,649 |
| Massachusetts | 1,845 | 964 | 2,669 | 59,347 | 49,334 |
| Rhode Island | 123 | 221 | 347 | 7,496 | 7,343 |
| Connecticut | 367 | 506 | 1,075 | 22,820 | 17,757 |
| *Total New England* | 2,547 | 1,930 | 4,679 | 105,902 | 88,220 |
| New York | 8,058 | 9,798 | 12,628 | 173,458 | 175,253 |
| New Jersey | 1,809 | 1,367 | 2,634 | 61,335 | 55,742 |
| Pennsylvania | 4,657 | 1,524 | 3,760 | 113,152 | 114,376 |
| *Total Middle Atlantic* | 14,524 | 12,689 | 19,022 | 347,945 | 345,371 |
| Ohio | 2,634 | 1,488 | 2,967 | 95,748 | 85,595 |
| Indiana | 728 | 366 | 857 | 36,468 | 32,423 |
| Illinois | 2,933 | 2,287 | 2,358 | 143,996 | 91,568 |
| Michigan | 1,663 | 492 | 1,824 | 60,039 | 48,085 |
| Wisconsin | 486 | 255 | 547 | 24,669 | 20,065 |
| *Total East No. Central* | 8,444 | 4,888 | 8,553 | 360,920 | 277,736 |
| Minnesota | 342 | 280 | 704 | 20,507 | 16,645 |
| Iowa | 327 | 178 | 342 | 23,930 | 19,662 |
| Missouri | 553 | 442 | 1,174 | 43,018 | 49,860 |
| North Dakota | 35 | 41 | 62 | 3,922 | 3,034 |
| South Dakota | 85 | 35 | 69 | 4,987 | 3,954 |
| Nebraska | 177 | 113 | 233 | 15,751 | 14,043 |
| Kansas | 188 | 198 | 249 | 18,393 | 19,744 |
| *Total West No. Central* | 1,707 | 1,287 | 2,833 | 130,508 | 126,942 |
| Delaware | 96 | 59 | 101 | 3,075 | 2,887 |
| Maryland | 451 | 447 | 596 | 20,644 | 24,166 |
| District of Columbia | 698 | 373 | 467 | 11,644 | 12,108 |
| Virginia | 465 | 291 | 552 | 20,980 | 20,795 |
| West Virginia | 197 | 124 | 329 | 15,205 | 17,283 |
| North Carolina | 429 | 192 | 316 | 24,778 | 19,881 |
| South Carolina | 243 | 266 | 265 | 12,428 | 9,459 |
| Georgia | 452 | 350 | 725 | 27,131 | 28,894 |
| Florida | 3,080 | 1,479 | 1,645 | 24,508 | 14,883 |
| *Total South Atlantic* | 6,111 | 3,581 | 4,996 | 160,393 | 150,356 |
| Kentucky | 308 | 319 | 435 | 16,590 | 18,812 |
| Tennessee | 400 | 252 | 893 | 24,110 | 26,198 |
| Alabama | 351 | 231 | 415 | 21,412 | 16,516 |
| Mississippi | 139 | 127 | 167 | 7,161 | 5,046 |
| *Total East So. Central* | 1,198 | 929 | 1,910 | 69,273 | 66,572 |
| Arkansas | 4 | 79 | 203 | 9,886 | 8,764 |
| Louisiana | 498 | 188 | 430 | 14,105 | 9,385 |
| Oklahoma | 175 | 92 | 181 | 16,384 | 17,260 |
| Texas | 1,708 | 760 | 1,640 | 60,877 | 51,100 |
| *Total West So. Central* | 2,385 | 1,119 | 2,454 | 101,252 | 86,509 |
| Montana | 63 | 35 | 208 | 6,199 | 4,978 |
| Idaho | 65 | 59 | 176 | 6,914 | 4,228 |
| Wyoming | 33 | 15 | 62 | 2,441 | 2,145 |
| Colorado | 232 | 74 | 171 | 11,401 | 10,158 |
| New Mexico | 48 | 30 | 48 | 3,193 | 2,381 |
| Arizona | 104 | 113 | 125 | 5,559 | 3,471 |
| Utah | 40 | 50 | 176 | 7,171 | 5,747 |
| Nevada | 44 | 50 | 51 | 1,837 | 1,209 |
| *Total Mountain* | 629 | 426 | 1,017 | 44,715 | 34,317 |
| Washington | 454 | 126 | 1,120 | 21,125 | 17,530 |
| Oregon | 243 | 126 | 529 | 14,135 | 14,707 |
| California | 5,464 | 2,466 | 6,509 | 111,021 | 64,071 |
| *Total Pacific* | 6,161 | 2,718 | 8,158 | 146,281 | 96,308 |

Figures based on report issued by the National Electric Manufacturers Association.

# Food Cost Up—Electricity Down

## Some Advertisements and Cartoons on the Subject—Latest Figures of U. S. Bureau of Labor Statistics Show Sustained Rise in Living Costs and New Low Prices for Electricity—All Data to Be Revised on New Basis

A NUMBER of public utilities have dramatized in newspaper advertisements the downward trend in electric rates through contrast with the recent increases in living costs. Most of the advertisements of this type are running in series, in some cases as many as twenty-four advertisements have been built around this theme. The advertisements reproduced on the following pages have been greatly reduced in size, in some cases they originally appeared in newspapers full page size.

An interesting development of the situation is that the customary indexes of the government on the cost of living are soon to be abandoned and replaced by others that will make the situation appear much better.

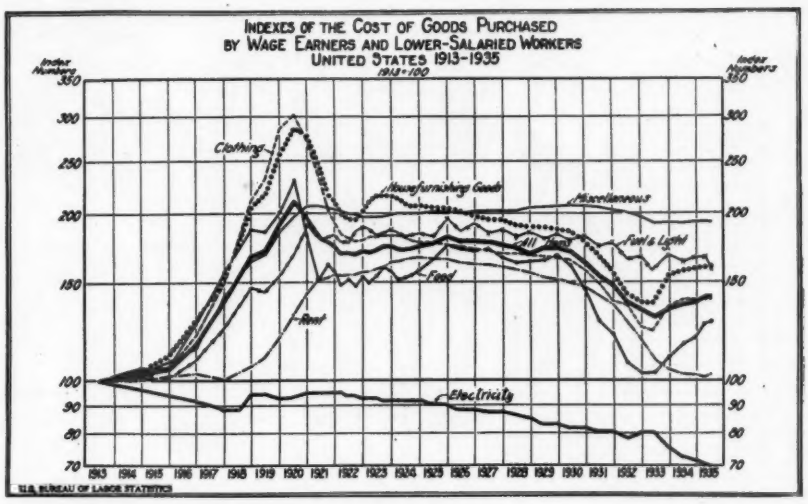
On November 9th, the New York Times carried the following Washington dispatch:

"WASHINGTON, Nov. 8 (AP)—The Department of Labor in a bi-weekly report now is comparing current retail food prices with the 1923-25 average as well as with 1913. Eventually, Secretary Perkins said, the 1913 comparisons will be dropped. This change, she said, was recommended by the American Statistical Society and would bring the report into line with other government statistical reports.

"Although the change would make today's prices smaller than the base, where the 1913 comparisons made them greater, Miss Perkins denied that the change had any political ramifications.

" 'There is no attempt to conceal anything,' she said."

The last report on electricity by the Department of Labor covered February, 1935, and since that time the publications no longer show the ratios to the 1913 figures, but only the net prices for specific quantities used per month in each of the selected cities. A committee of the Statistical Department of the Edison Electric Institute hopes soon to present a complete study of the subject of the cost of living, which at the moment is in a somewhat chaotic condition. In the meantime, the latest information on the cost of living is set forth here by charts and tables, together with some indications of the state of public opinion, as conveyed by current newspaper cartoons, as well as the advertisements referred to in the opening paragraph.




*Note: The curve for electricity is based on the amounts of current used by the "wage earners and lower-salaried workers" to which class alone the "cost of living" figures apply. It must not be confused with the curve of the average price of all domestic service computed monthly by the Edison Electric Institute, which includes the use of energy by the well-to-do and whose figures are influenced not only by rate reductions but by increases in the quantities used as well.*

INDEXES OF THE COST OF GOODS PURCHASED BY WAGE EARNERS AND LOWER-SALARIED WORKERS IN 32 LARGE CITIES OF THE UNITED STATES COMBINED, 1913 TO JULY 15, 1935

| Date | Index numbers (1913=100.00) | | | | | | |
|---|---|---|---|---|---|---|---|
| | All Items | Food | Clothing | Rent | Fuel and Light | House furnishing Goods | Miscellaneous |
| Average, 1913 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| December 1914 | 102.7 | 105.0 | 101.0 | 100.0 | 101.0 | 104.0 | 103.0 |
| December 1915 | 104.7 | 105.0 | 104.7 | 101.5 | 101.0 | 110.6 | 107.4 |
| December 1916 | 116.6 | 126.0 | 120.0 | 102.3 | 108.4 | 127.8 | 113.3 |
| December 1917 | 138.3 | 157.0 | 149.1 | 100.1 | 124.1 | 150.6 | 140.5 |
| December 1918 | 166.9 | 187.3 | 213.4 | 105.3 | 146.0 | 205.0 | 163.3 |
| June 1919 | 171.1 | 185.9 | 231.1 | 109.6 | 144.2 | 218.0 | 168.0 |
| December 1919 | 191.4 | 200.4 | 286.3 | 119.0 | 153.1 | 257.8 | 185.4 |
| June 1920 | 211.3 | 231.6 | 302.6 | 129.2 | 169.3 | 287.2 | 197.8 |
| December 1920 | 195.6 | 183.3 | 271.1 | 142.5 | 192.0 | 278.3 | 205.8 |
| May 1921 | 179.1 | 151.8 | 233.0 | 150.9 | 182.2 | 239.7 | 205.8 |
| December 1921 | 174.8 | 157.9 | 192.5 | 154.4 | 183.4 | 210.5 | 203.4 |
| June 1922 | 169.0 | 151.5 | 180.3 | 154.6 | 177.2 | 195.5 | 198.4 |
| December 1922 | 170.3 | 153.2 | 178.4 | 156.0 | 189.0 | 201.8 | 197.3 |
| June 1923 | 171.8 | 154.0 | 181.4 | 158.4 | 182.7 | 215.5 | 197.6 |
| December 1923 | 174.7 | 157.7 | 182.8 | 162.3 | 187.2 | 215.6 | 199.4 |
| June 1924 | 172.3 | 152.1 | 180.6 | 164.9 | 180.8 | 208.4 | 199.1 |
| December 1924 | 174.3 | 157.7 | 177.5 | 165.6 | 184.3 | 207.7 | 199.8 |
| June 1925 | 176.7 | 165.1 | 176.9 | 165.1 | 181.4 | 205.2 | 201.1 |
| December 1925 | 181.3 | 176.1 | 175.8 | 165.0 | 196.0 | 205.0 | 201.6 |
| June 1926 | 178.7 | 172.6 | 174.2 | 163.5 | 185.2 | 200.9 | 201.5 |
| December 1926 | 178.3 | 171.3 | 172.7 | 162.8 | 191.4 | 198.6 | 202.1 |
| June 1927 | 177.7 | 172.2 | 171.0 | 161.1 | 184.8 | 195.8 | 202.8 |
| December 1927 | 175.1 | 165.8 | 168.7 | 159.4 | 187.0 | 195.0 | 203.7 |
| June 1928 | 172.9 | 162.4 | 168.4 | 157.2 | 181.6 | 191.0 | 203.6 |
| December 1928 | 173.3 | 163.6 | 167.4 | 155.5 | 185.3 | 189.8 | 205.0 |
| June 1929 | 172.8 | 164.3 | 166.6 | 153.5 | 180.2 | 189.1 | 205.4 |
| December 1929 | 173.7 | 167.5 | 165.6 | 151.9 | 184.2 | 188.4 | 206.1 |
| June 1930 | 170.3 | 160.4 | 164.3 | 149.8 | 178.1 | 186.1 | 206.8 |
| December 1930 | 163.6 | 145.9 | 158.1 | 146.7 | 182.2 | 178.4 | 206.3 |
| June 1931 | 153.9 | 127.7 | 149.7 | 142.1 | 174.2 | 166.2 | 205.0 |
| December 1931 | 148.4 | 120.8 | 139.3 | 136.6 | 177.0 | 156.9 | 203.1 |
| June 1932 | 138.9 | 107.2 | 131.9 | 127.8 | 165.0 | 143.4 | 200.2 |
| December 1932 | 133.5 | 102.6 | 124.7 | 118.3 | 166.9 | 137.5 | 197.1 |
| June 1933 | 129.8 | 102.8 | 122.8 | 108.7 | 157.8 | 137.8 | 192.3 |
| December 1933 | 134.6 | 110.0 | 136.7 | 104.0 | 167.3 | 154.1 | 193.0 |
| June 1934 | 136.5 | 116.1 | 139.8 | 102.1 | 162.9 | 157.2 | 192.7 |
| November 15, 1934 | 137.8 | 119.1 | 139.7 | 102.0 | 165.4 | 158.3 | 192.9 |
| July 15, 1935 | 140.2 | 127.1 | 139.6 | 102.1 | 157.8 | 159.8 | 192.8 |

U. S. Bureau of Labor Statistics.

## Percentage Decrease Since December 1913 in the Price of Electricity in 32 Cities Combined

### December, 1914, to February, 1935

| Date | Percentage decrease from December 1913 | Date | Percentage decrease from December 1913 | Date | Percentage decrease from December 1913 |
|---|---|---|---|---|---|
| December 1914 | 3.7 | December 1922 | 7.4 | June 1929 | 17.3 |
| December 1915 | 6.2 | June 1923 | 7.4 | December 1929 | 17.3 |
| December 1916 | 8.6 | December 1923 | 8.6 | June 1930 | 18.5 |
| December 1917 | 11.1 | June 1924 | 8.6 | December 1930 | 18.5 |
| June 1918 | 11.1 | December 1924 | 8.6 | June 1931 | 19.8 |
| December 1918 | 6.2 | June 1925 | 9.9 | December 1931 | 19.8 |
| June 1919 | 6.2 | December 1925 | 9.9 | June 1932 | 21.0 |
| December 1919 | 7.4 | June 1926 | 11.1 | December 1932 | 19.8 |
| June 1920 | 7.4 | December 1926 | 11.1 | June 1933 | 19.8 |
| December 1920 | 4.9 | June 1927 | 12.3 | December 1933 | 24.7 |
| May 1921 | 4.9 | December 1927 | 12.3 | June 1934 | 27.2 |
| December 1921 | 4.9 | June 1928 | 13.6 | November 1934 | 28.4 |
| June 1922 | 6.2 | December 1928 | 14.8 | February 1935 | 29.6 |

U. S. Bureau of Labor statistics.

NEW YORK WORLD-TELEGRAM

## 7 Per Cent Increase in Living Cost in a Year Worries Officials

By the United Press.

WASHINGTON, Nov. 7.—The New Deal, which has fathered a long list of alphabetical combinations, found a new and unwanted one on its doorstep today.

Administration leaders were concerned over the HCL—"high cost of living—as reflected in continued increases in retail food prices and rents.

The Bureau of Labor Statistics has issued a report revealing that it now costs the average housewife about 7 per cent more—an average of perhaps $1.50 a week—to fill the family market basket than it did a year ago. It costs 25 per cent—about $6 a week—more than it did three years ago.

Food prices are 17.6 per cent of what they were in 1913, when the national income was approximately the same. Prices still are 17.7 per cent below 1930, however, the bureau reported. The percentage of the family budget which must go for food is higher, on the other hand.

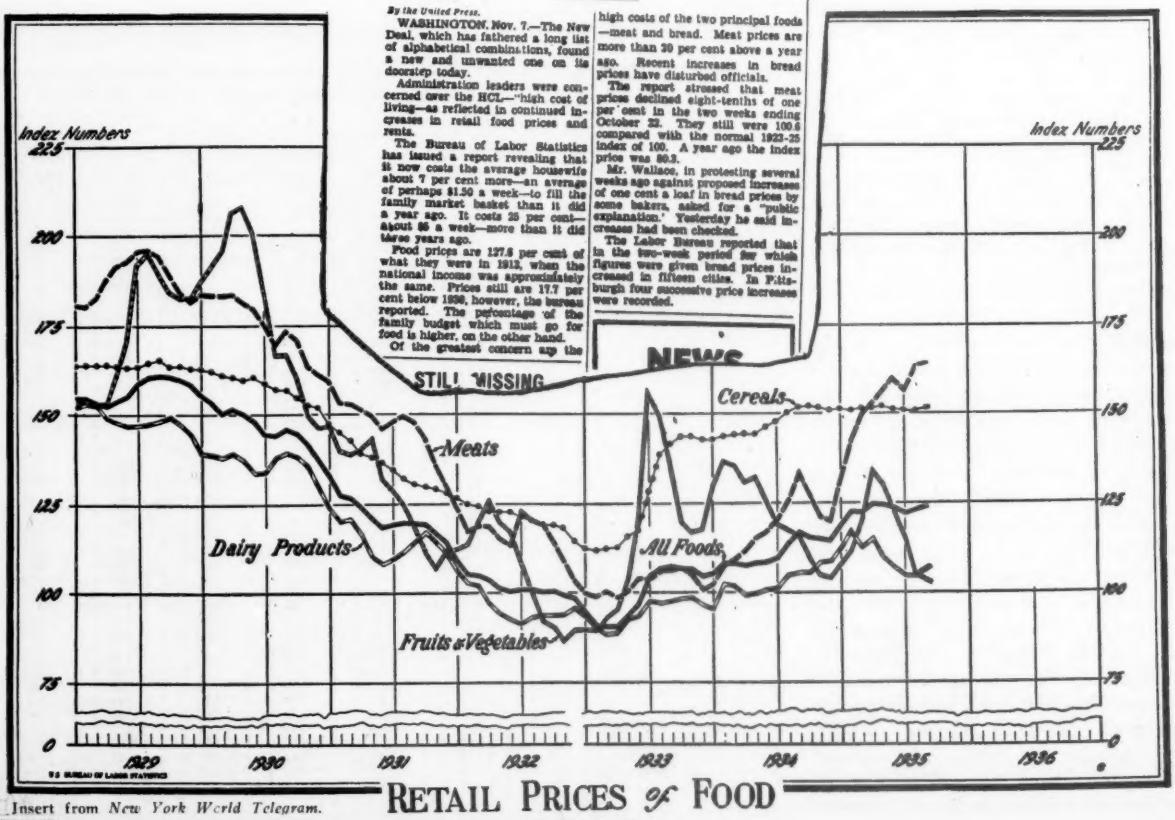
Of the greatest concern are the high costs of the two principal foods—meat and bread. Meat prices are more than 30 per cent above a year ago. Recent increases in bread prices have disturbed officials.

The report stressed that meat prices declined eight-tenths of one per cent in the two weeks ending October 22. They still were 100.6 compared with the normal 1923-25 index of 100. A year ago the index price was 80.3.

Mr. Wallace, in protesting several weeks ago against proposed increases of one cent a loaf in bread prices by some bakers, asked for a "public explanation.' Yesterday he said increases had been checked.

The Labor Bureau reported that in the two-week period for which figures were given bread prices increased in fifteen cities. In Pittsburgh four successive price increases were recorded.

STILL MISSING




Insert from *New York World Telegram.*

RETAIL PRICES of FOOD
1913 = 100

# The Original Alphabetical Pest

© Paterson, N. J., *News*, Thomas, 1935.

© New York *Times*

THE ONE DELIVERY SO FAR

Copyright, 1935, New York Tribune Inc.

© New York *Herald-Tribune*

# Bringing HOME the Bacon IN 1935

● An unwarranted attack upon private electric companies, through cleverly worded publicity, has focused public attention upon electricity. This advertisement is published to show that the cost of other home luxuries, greater several cost in the average family has been deliberately increased while the cost of electricity has continued to decrease.

● Food prices continue to shoot sky-high. The job of bringing home the bacon becomes more of a problem each week as thousands of housewives frantically attempt to balance their household budgets. Take breakfast bacon, for example—back in March of 1933 it was advertised in Mississippi as low as 7c per pound—only recently bacon was advertised at 35c—an increase of 400%.

The cost of food in Mississippi, since June, 1933, has pyramided 30%, adding $11,906,000 to our grocery bills.

Electricity, however, is one item on your household budget that has NOT GONE UP — the average residential electric rate of our company has GONE DOWN 20.4% since 1933, thus keeping it the smallest of home expenses.

RESIDENTIAL ELECTRICITY Reduced 20.4% SINCE 1933 D O W N

The WHOLESALE Step-Down residential electric rates of our company bring low-cost electric service within the reach of every home.

**Don't Blame YOUR BUTCHER**

The increase in food cost has been caused by the planned inflation of commodity prices through processing taxes and other measures entirely beyond his control.

MISSISSIPPI POWER & LIGHT COMPANY
A BASIC MISSISSIPPI INDUSTRY
EMPLOYING HUNDREDS OF MISSISSIPPIANS — ONE OF THE STATE'S LARGEST TAXPAYERS

PB-273-35

# You're in the Army Now—...

## COST OF FOOD *increased 30% since June, 1933*

● Whether you like it or not, you are in the army of those who are paying HIGHER prices for pork, flour, beef, eggs, navy beans, potatoes and numerous other articles — prices that have been purposely increased by new legislation and special taxation. In fact, food cost in Mississippi has increased 30% since June 1933, adding $11,906,000 to our grocery bills.

Electricity, however, in spite of rising prices, has continued downward in cost. In the communities served by our company, average residential rates are now 20.4% BELOW the 1933 average.

And so, again, as the cost of living GOES UP the cost of electricity GOES DOWN — and today electric service still holds the honor of being the smallest item in the average household budget.

● An unwarranted attack upon private electric companies, through cleverly worded publicity, has focused public attention upon electricity. This advertisement is published to show that the cost of other home luxuries, greater several cost in the average family has been deliberately increased while the cost of electricity has continued to decrease.

RESIDENTIAL ELECTRICITY Reduced 20.4% SINCE 1933 D O W N

The WHOLESALE Step-Down residential electric rates of our company bring low-cost electric service within the reach of every home.

**Don't BLAME YOUR GROCER**

The increase in food cost has been caused by the planned inflation of commodity prices through processing taxes and other measures entirely beyond his control.

MISSISSIPPI POWER & LIGHT COMPANY
A BASIC MISSISSIPPI INDUSTRY
EMPLOYING HUNDREDS OF MISSISSIPPIANS — ONE OF THE STATE'S LARGEST TAXPAYERS

PB-186-35

# THE COW JUMPED OVER THE MOON

## ...and she's jumping still higher

* *Statistics Reveal That Good Old Roast Beef Has Gone Up 39.2%; and Round Steak 61.3% During the Past Two Years in Memphis (June, 1933-June, 1935).*

**Now there's a fact that's no laughing matter. The steady, continued rise of beef for the past two years has "dented" rather than "nicked" the family budget.**

**And beef isn't the only one. Practically all foods and necessities have jumped sky high.**

**Yet there's one bright spot!**

**During this same period, right here in Memphis, the average cost of electricity for Memphis families has SHOWN A DECREASE OF 14.6%.**

**Yes—food prices have gone up but electricity has gone down. It's Memphis' biggest bargain.**

This is one of a series of advertisements in which it is our purpose to show that electricity is cheap, is declining in cost and is not an important item of the family budget. Through cleverly directed publicity, public attention has been focused upon electricity, which has declined in cost, while the prices of other items involving greater annual cost to the family have been deliberately increased through legislative enactment and tax impositions.

**ELECTRICITY**
*Cost in Memphis*
**HAS GONE DOWN**
**14.6%**

ELECTRICITY
**MEMPHIS POWER & LIGHT COMPANY**
MEMPHIS' BIGGEST BARGAIN

# The Staff of Life NOW BEARS A HEAVY LOAD

***Comparison of cost between June 1933 and June 1935 shows that Bread, the staff of life, has increased 25.4% in Memphis.***

**Meeting the increased cost of daily food necessities is a serious problem for the Memphis housewife. Bread—an important part of each meal—costs a great deal more today than two years ago. And this increase, along with the new high prices of other commodities, has a very telling effect on the Memphis housewives' budget. There is no getting around this increase. The price has to be met.**

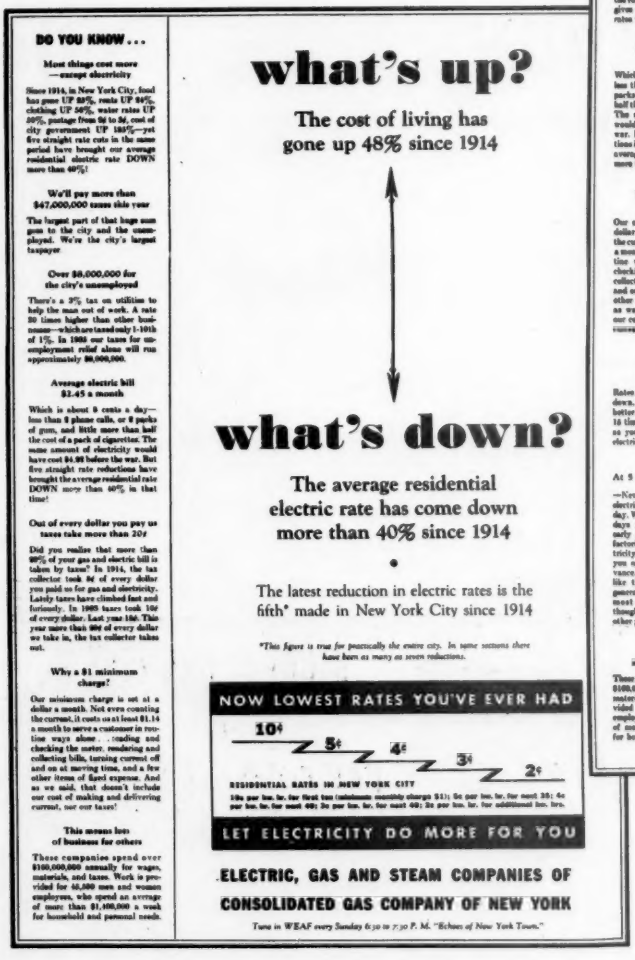
**Despite this marked upward trend there is one basic necessity that has dropped in price in Memphis—ELECTRICITY. In the past two years the average cost of electricity for Memphis families has come down 14.6%. This proves very definitely that electricity is Memphis' Biggest Bargain today.**

This is one of a series of advertisements in which it is our purpose to show that electricity is cheap, is declining in cost and is not an important item of the family budget. Through cleverly directed publicity, public attention has been focused upon electricity, which has declined in cost, while the prices of other items involving greater annual cost to the family have been deliberately increased through legislative enactment and tax impositions.

* The increase in commodity prices has been caused by inflation of our currency and by processing and other taxes, entirely beyond the control of Memphis retailers.

**ELECTRICITY**
*Cost in Memphis*
**HAS GONE DOWN**
**14.6%**

ELECTRICITY
**MEMPHIS POWER & LIGHT COMPANY**
MEMPHIS' BIGGEST BARGAIN



DO YOU KNOW...

**Most things cost more —except electricity**

Since 1914, in New York City, food has gone UP 25%, rents UP 24%, clothing UP 56%, water rates UP 50%, postage from 2¢ to 3¢, cost of city government UP 185%—yet five straight rate cuts in the same period have brought our average residential electric rate DOWN more than 40%!

**We'll pay more than $47,000,000 taxes this year**

The largest part of that huge sum goes to the city and the unemployed. We're the city's largest taxpayer

**Over $8,000,000 for the city's unemployed**

There's a 3% tax on utilities to help the man out of work. A rate 30 times higher than other businesses—which are taxed only 1-10th of 1%. In 1935 our taxes for unemployment relief alone will run approximately $8,000,000.

**Average electric bill $2.45 a month**

Which is about 8 cents a day—less than 2 phone calls, or 2 packs of gum, and little more than half the cost of a pack of cigarettes. The same amount of electricity would have cost $4.90 before the war. But five straight rate reductions have brought the average residential rate DOWN more than 40% in that time!

**Out of every dollar you pay us taxes take more than 20¢**

Did you realize that more than 20% of your gas and electric bill is taken by taxes? In 1914, the tax collector took 8¢ of every dollar you paid us for gas and electricity. Lately taxes have climbed fast and furiously. In 1935 taxes took 10¢ of every dollar. Last year 18¢. This year more than 20¢ of every dollar we take in, the tax collector takes out.

**Why a $1 minimum charge?**

Our minimum charge is not at a dollar a month. Not even counting the current, it costs us at least $1.14 a month to serve a customer in routine ways alone . . . reading and checking the meter, rendering and collecting bills, turning current off and on at moving time, and a few other items of fixed expense. And as we said, that doesn't include our cost of making and delivering current, nor our taxes!

**This means loss of business for others**

These companies spend over $100,000,000 annually for wages, materials, and taxes. Work is provided for 60,000 men and women employees, who spend an average of more than $1,000,000 a week for household and personal needs.

# what's up?

The cost of living has gone up 48% since 1914

# what's down?

The average residential electric rate has come down more than 40% since 1914

•

The latest reduction in electric rates is the fifth* made in New York City since 1914

*This figure is true for practically the entire city. In some sections there have been as many as seven reductions.

NOW LOWEST RATES YOU'VE EVER HAD

10¢ 5¢ 4¢ 3¢ 2¢

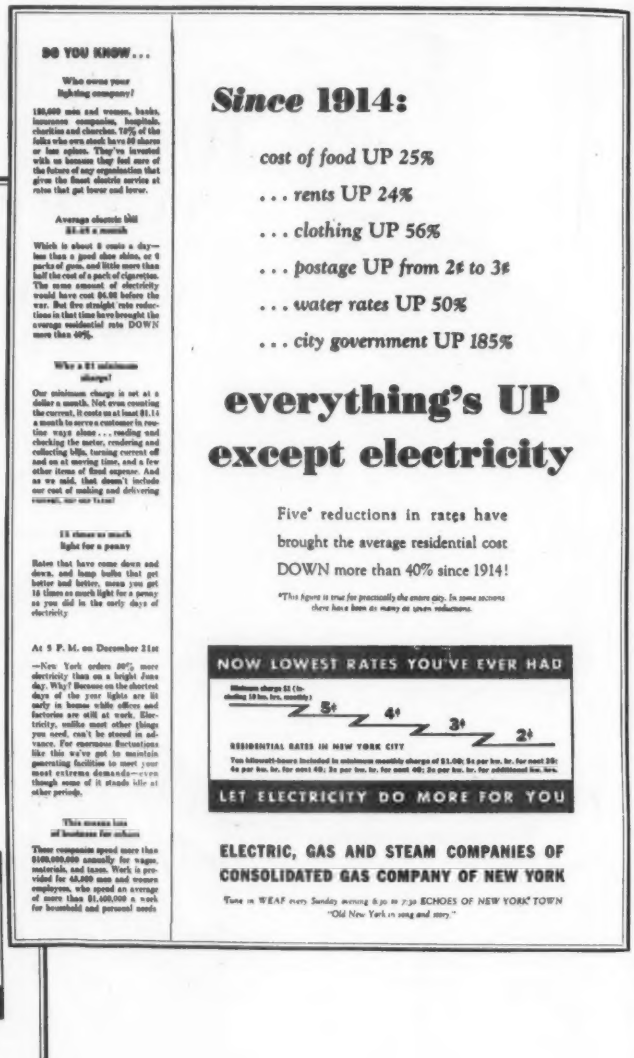
RESIDENTIAL RATES IN NEW YORK CITY

10¢ per kw. hr. for first ten (minimum monthly charge $1); 5¢ per kw. hr. for next 25; 4¢ per kw. hr. for next 40; 3¢ per kw. hr. for next 60; 2¢ per kw. hr. for additional kw. hrs.

LET ELECTRICITY DO MORE FOR YOU

**ELECTRIC, GAS AND STEAM COMPANIES OF CONSOLIDATED GAS COMPANY OF NEW YORK**

Tune in WEAF every Sunday morning 6:30 to 7:30 P. M. "Echoes of New York Town."



DO YOU KNOW...

**Who owns your lighting company?**

180,000 men and women, banks, insurance companies, hospitals, charities and churches. 70% of the folks who own stock have 50 shares or less apiece. They've invested with us because they feel sure of the future of any organization that gives the finest electric service at rates that get lower and lower.

**Average electric bill $2.45 a month**

Which is about 8 cents a day—less than a good shoe shine, or 2 packs of gum, and little more than half the cost of a pack of cigarettes. The same amount of electricity would have cost $4.90 before the war. But five straight rate reductions in that time have brought the average residential rate DOWN more than 40%.

**Why a $1 minimum charge?**

Our minimum charge is not at a dollar a month. Not even counting the current, it costs us at least $1.14 a month to serve a customer in routine ways alone . . . reading and checking the meter, rendering and collecting bills, turning current off and on at moving time, and a few other items of fixed expense. And as we said, that doesn't include our cost of making and delivering current, nor our taxes!

**14 times as much light for a penny**

Rates that have come down and down, and lamp bulbs that get better and better, mean you get 14 times as much light for a penny as you did in the early days of electricity.

**At 5 P. M. on December 21st**

—New York orders 20% more electricity than on a bright June day. Why? Because on the shortest days of the year lights are lit early in homes while offices and factories are still at work. Electricity, unlike most other things you need, can't be stored in advance. For enormous fluctuations like this we've got to maintain generating facilities to meet your most extreme demands—even though some of it stands idle at other periods.

**This means loss of business for others**

These companies spend more than $100,000,000 annually for wages, materials, and taxes. Work is provided for 60,000 men and women employees, who spend an average of more than $1,000,000 a week for household and personal needs.

# *Since* 1914:

*cost of food* UP 25%

. . . *rents* UP 24%

. . . *clothing* UP 56%

. . . *postage* UP *from* 2¢ *to* 3¢

. . . *water rates* UP 50%

. . . *city government* UP 185%

# everything's UP except electricity

Five* reductions in rates have brought the average residential cost DOWN more than 40% since 1914!

*This figure is true for practically the entire city. In some sections there have been as many as seven reductions.

NOW LOWEST RATES YOU'VE EVER HAD

Minimum charge $1 (including 10 kw. hrs. monthly)

5¢ 4¢ 3¢ 2¢

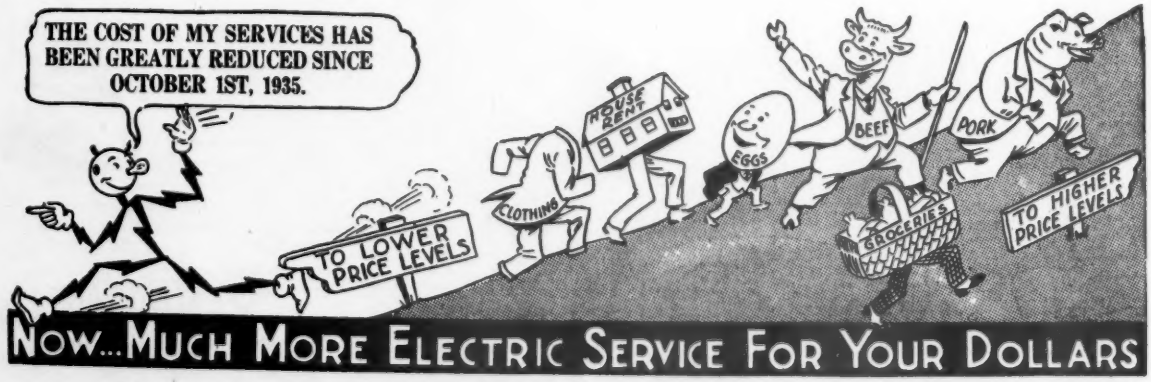
RESIDENTIAL RATES IN NEW YORK CITY

Ten kilowatt-hours included in minimum monthly charge of $1.00; 5¢ per kw. hr. for next 25; 4¢ per kw. hr. for next 40; 3¢ per kw. hr. for next 60; 2¢ per kw. hr. for additional kw. hrs.

LET ELECTRICITY DO MORE FOR YOU

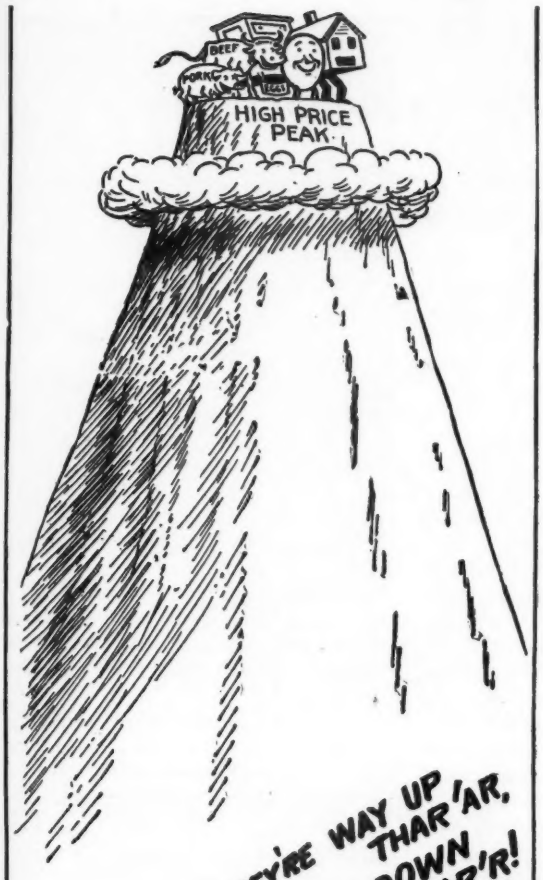
**ELECTRIC, GAS AND STEAM COMPANIES OF CONSOLIDATED GAS COMPANY OF NEW YORK**

Tune in WEAF every Sunday morning 6:30 to 7:30 ECHOES OF NEW YORK' TOWN "Old New York in song and story."




**Pennsylvania Power & Light Company**

Carlisle Gas & Water Co.




# ELECTRIC SERVICE ...*is Cheap* IN AKRON

**OHIO EDISON CO.**

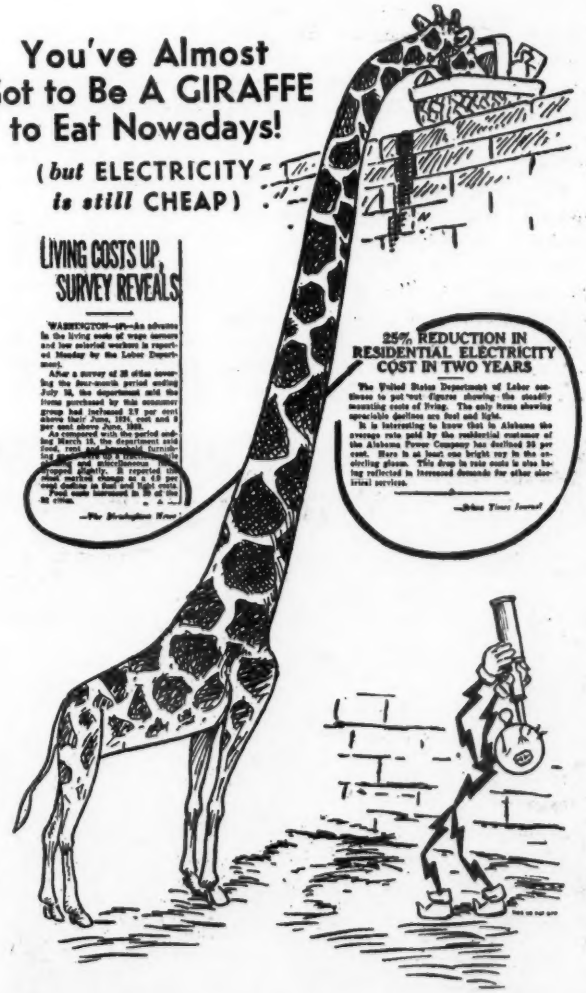
## *Yes, Madam ... but the electric rate has gone down*

*Our Simplified NEW LOW RATE gives you much more Electric Service for your Dollars . . . .*

**PENNSYLVANIA POWER & LIGHT COMPANY**
CARLISLE GAS AND WATER CO.

## You've Almost Got to Be A GIRAFFE to Eat Nowadays!

(*but* ELECTRICITY *is still* CHEAP)




## ALABAMA POWER COMPANY

Electrify Now—
Electricity Is CHEAP In Alabama

# Whitwell and Skinner Awarded McGraw Medal for Leadership in Better Light-Better Sight

## Five Hundred Attend Dinner in Their Honor—McCarter and Carlisle Principal Speakers

BEFORE a representative group of more than five hundred executives of the electrical and the optical industries gathered at a dinner at the Biltmore Hotel on Dec. 10th, George E. Whitwell, Vice President of the Philadelphia Electric Company, and Merrill E. Skinner, Assistant Vice President of the Niagara Hudson Power Corporation, were presented with the medal and certificate of the James H. McGraw Award for Cooperation, given for their work in the National Better Light-Better Sight movement. Mr. Whitwell was honored as the originator of the movement, which was termed "one of the most ambitious projects ever attempted by men of business for the public welfare," and Skinner for his work as chairman of the Better Light-Better Sight Bureau, representing nineteen national associations and groups, which has led the development of the Better Light-Better Sight program. The McGraw award is given annually for the most important personal contribution toward cooperative efforts and achievements in the electrical industry.

Floyd M. Carlisle, chairman of the board of the Consolidated Gas Company of New York and of the Niagara Hudson Power Corporation, Thomas N. McCarter, President of the Edison Electric Institute and of the Public Service Electric and Gas Company of New Jersey, and Dr. Conrad Berens, widely known eye surgeon of the staff of the New York Eye and Ear Infirmary, delivered the main addresses. Frank W. Smith, President of the Consolidated Gas Company of New York and affiliated electrical companies, presided as chairman of the dinner committee. L. A. S. Wood, president of the Illuminating Engineering Society, spoke as the representative of that organization. The dinner was given jointly by the Edison Electric Institute and the Illuminating Engineering Society.

Formal presentation of the award was made by Earl Whitehorne of the McGraw-Hill Publishing Company. In his citation of Messrs. Whitwell and Skinner, Mr. Whitehorne said of the Better Light-Better Sight movement that "The initiation and achievement of this great continuing movement coordinating the activities of the Edison Electric Institute, the Illuminating Engineering Society, the Better Vision Institute, the National Paint, Varnish and Lacquer Association and the vast diversified professions, industries and trades which they represent, constitutes one of the most ambitious projects ever attempted by men of business for the public welfare."

Mr. Carlisle, in his address, said: "I personally believe that a tremendous growth lies just ahead of us. Better Light-Better Sight, a vast extension of refrigeration, electric cooking, water heating and air-conditioning—these developments are largely a matter of our abilities as merchants of electricity, be-

*The Better Light-Better Sight Dinner (not all of the tables appear in this picture)*

**CITATION TO MR. WHITWELL**

GEORGE E. WHITWELL, vice-president of the Philadelphia Electric Company, has wrought a profound influence upon the commercial thinking of the power industry and through his penetrating study of the markets for electrical energy and his courage in combating the restrictions of tradition, has advanced the economic knowledge of utility sales managements and stimulated them to broader and more effective operations. Several years ago he became convinced of the fundamental importance of lighting, both to the development of the electrical industry and in the value of electric service to the public. He recognized, however, that enduring progress in lighting standards and practice, could be built only upon the firm base of a popular appreciation of what good lighting means to the welfare of men, women and children. Therefore, as chairman of the Sales Committee of the Edison Electric Institute in 1933, he launched a crusade for public education in the conservation of eyesight, and established a committee to organize the resources of the electrical industry in its support, to which he has continued to give the inspiration of his leadership.

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cause essentially we are manufacturers and merchants of our many and varied services.

"Our kilowatthour sales have now reached an all-time peak. The tax burdens and rate reductions have, however, depressed our earnings available for interest and dividends. These can be recovered in a period of prosperity, assuming the continuation of our traditional system of government. Assuming this—and because the industry is, with few exceptions, so basically sound, the conduct of its business is so fundamentally right, the charges for its services so reasonable and the use for it so varied—the industry has nothing to fear except its own lack of ability. It must advance its ablest men, constantly looking to promote its promising youngsters. It must be frank and open in its dealings, intelligent and competent in its production and aggressive and farsighted in its salesmanship.

"I venture to say that no industry in the world's history has contributed any more completely to the economic good and the actual physical comfort and well-being of all classes of mankind. The future great historian of this era in America—a possible Gibbon, writing with meticulous attention to facts when the heat of political controversy is cold and the last TVA and yardstick plant has wrought its good or evil, this future Gibbon will give to our industry credit for having done one of the outstanding jobs of our time."

Mr. Carlisle credited the Better Light-Better Sight movement with breathing new life into the lighting business of the electrical industry, and at the same time bringing about the realization that the whole field of lighting was susceptible of enormous change and improvement. Proposing a campaign for adequate highway lighting in the cause of safety, Mr. Carlisle said: "We all know that the country is greatly wrought up now on the subject of safety in automobile driving. Last year some 36,000 persons lost their lives, and literally hundreds of thousands were injured in automobile accidents. Is it not possible that this same approach which has been so successfully used in the 'Better Light-Better Sight' campaign can be carried into the field of highway lighting in somewhat the same manner? Everyone in this industry realizes the social and economic advantages of properly lighted highways. Some years ago we all recognized the social and economic advantages of proper lighting, too. But it was only when the impetus of such a campaign as this was put behind the movement that real results were attained."

Mr. McCarter, in giving credit to the work of Mr. Whitwell, Mr. Skinner, and others connected with the movement, discussed the extraordinary growth and influence of the Better Light-Better Sight program, which, starting in 1933 as a lighting activity of the electrical industry, has now broadened into a nation-wide cooperative movement of the electrical, optical and painting industries to promote eye health and eyesight conservation, through scientifically applied illumination, light prescribing technique for eye refraction, and light reflecting surfaces.

**CITATION TO MR. SKINNER**

MERRILL E. SKINNER, assistant vice-president of the Niagara Hudson Power Corporation, for many years has been outstanding among power company sales executives, for his energy, enthusiasm and ability in the pioneering of new markets and the improvement of the technique of load development. He was one of the first to sense the possibilities for increasing lighting business during the depression and conducted experiments on the Niagara Hudson system which provided a groundwork for the Better Light-Better Sight concept and led to his appointment as chairman of the national committee. He proceeded to marshall the man power of the lighting industries—the manufacturers, distributors, retailers and installers of lamps and lighting equipment, the illuminating engineers and electric light and power companies—and to arouse the interest of the optical and paint industries, the insurance underwriters, the educational authorities and the public health service. And by the sheer strength of his conviction and the impelling force of his leadership, he has set up a balanced program of public education, lighting inspection and re-equipment, that is carrying the gospel of sight saving into homes, schools, stores, offices, factories and other working places throughout the land. This has been made possible by the development of improved lighting equipment, by the evolution of a new technique for demonstrating the use of light and for prescribing correct illumination for the relief of defective vision, and by the unprecedented expansion of lighting personnel within the electrical industry, operating under the national program and through local Sight Saving Councils.

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"Nineteen National Associations," said Mr. McCarter, "and groups within the electrical, the optical and the paint industries constitute the active membership of the National Better Light-Better Sight Bureau which in turn represents several hundreds of organizations and several hundreds of thousands of

men and women, a substantial number of the latter actively engaged in promoting Better Light-Better Sight and many others indirectly doing their bit by methods consistent with the interests of their respective organizations.

"Within the electric utility industry I am reliably informed that fully 80 per cent nationally are directly conducting or indirectly promoting an eyesight conservation program through Better Light for Better Sight. More than 5000 trained specialists on utility staffs are now devoting their full time to selling better 'seeing' in homes, stores and factories.

"In addition to this man and woman power the amount of advertising, educational and promotional, has been and is extensive.

"During the past two years reliable sources estimate over 11,000,000 column inches of newspaper advertising have been used on Better Light-Better Sight. This advertising, appearing in every important city in the United States and in the large majority of cities and towns of over 3000 population, represents approximately 400,000 newspaper advertisements to a circulation of over 40,000,000. Over 350 pages of trade paper advertising have been run in electrical, optical and paint publications. In over 30 of the leading national magazines, page advertisements have been run to a circulation of over 20,000,000.

"Over 30,000,000 pieces of educational direct mail material of various kinds have been distributed by members of the electrical, optical and paint industries.

"Over 200 radio stations, electric and optical interests have broadcast Better Light-Better Sight and eye conservation messages to millions of listeners through continuous programs.

"Eighty-five local cooperative Better Sight Bureaus and Sight Saving Councils have been organized composed of individuals interested in promoting eyesight conservation—and the list of such groups is increasing steadily."

In presenting the award to Messrs. Whitwell and Skinner, Mr. Whitehorne said, in part, "I have been thinking what a dramatic thing it is that for the third time in half a century light has captured the attention and interest of the American people . . . . today—after another quarter century—we see light in a new role. The electrical man's jargon of watts and lumens has been laid aside. Light has found its real worth in the world by forgetting itself. And the world is turning in real interest to hear how intelligent illumination can help the stricken eyes of man.

For the human eye has paid a heavy price for progress. A million years of physical evolution had produced a perfect device for seeing. But 500,000 years, from the Ape Man of Java to the beginning of the age of steam, men had worked in daylight, in a natural environment. Then came rapid travel, newspapers, magazines, books, intense light sources, moving pictures, night life. It has been estimated that the strain upon the eyes of men and women has increased in the last 125 years as from 1 to 2,000.

It is to the glory of the optical profession that they have so advanced their science as to bring an adequate relief to humanity by adjusting vision to these conditions so successfully. And it is to the glory of the lighting industries also that they now join forces with the optical industry to organize preventive measures for the protection of our eyes, by improving the standards of lighting under which people read, study and work.

Light now brings to the optical profession the power to prevent the causes of eye deterioration. Illuminating engineers have long preached prevention but people ignored such abstract warnings. We now talk "seeing" and the optical profession is prescribing light and John and Mary are beginning to understand. And in this work, I think electrical men are making their greatest social contribution.

What a privilege to participate in such an opportunity for creative service. So much in business is competitive. So much is conflict—where one man's gain is another's loss. But in this Better Light—Better Sight program we are embarked on a great adventure that is both constructive and beneficent. There is a commercial side, of course. There must be profit where industrial production is involved, to finance the expenses of education and improvement. But above all, in this endeavor, shines forth the compelling purpose to rescue our children and our children's children from the loss of their priceless heritage of good eyesight. And so I think that all of us should rejoice that light at last has come to life and found its voice for this broader service.

At the dinner, certificates of honorable mention were also awarded to a group of scientists and lighting specialists who have cooperated with the national committee in the development of the new "science of seeing" and the new technique for demonstrating, prescribing and applying light for the conservation of eyesight. These awards were:

To Dr. Matthew Luckiesh, Director of the Lighting Research Laboratories of the General Electric Company, at Nela Park, for his research into the relationship of light to sight and for his development of the "science of seeing."

To Dr. Clarence E. Ferree and Dr. Gertrude Rand, Directors of the Research Laboratory of Physiological Optics, Johns Hopkins Medical School of Baltimore, for their research into the relationship of light to sight and their development of a light prescribing equipment for the use of eyesight specialists.

To Michael J. Julian, President of the Better Vision Institute of New York, for organizing the cooperation of the optical industry and trade.

To William F. Little, Engineer, of the Electrical Testing Laboratories, of New York, for his development of the I.E.S. study and reading lamps to provide a high standard of illumination for the conservation of eyesight, maintained through a test and certification service.

To Edward F. Weston, President of the Weston Electrical Instrument Corporation of Newark, N. J., for the concept and development of the dry disk photo-cell light meter, making possible the demonstration of light intensity to the public.

To Earl L. Canfield, President of the Sight Light Corporation of New York, for his adaptation of the light meter, for measuring in terms of seeing, and his development of other light demonstrating equipment.

To H. Freeman Barnes, Manager of the Sales Promotion Department of the Incandescent Lamp Division of the General Electric Company at Nela Park, for dramatizing the story of light in its relation to vision and for developing a technique for demonstrating the conservation of eyesight.

To Joseph F. O'Brien, Advertising and Sales Promotion Manager of the Westinghouse Lamp Company of Bloomfield, N. J., for the development of demonstration technique and equipment for promoting the conservation of eyesight.

To C. Ernest Greenwood, Commercial Director of the Edison Electric Institute of New York, for his unflagging zeal and tireless effort in the development and guidance of the Better Light—Better Sight Program.

# Employee Selling

**By C. E. Greenwood**

*Commercial Director, Edison Electric Institute*

IT has been fundamental reasoning in the utility industry for many years that a company is known by the employees it keeps. The estimate of the electric service company by the people using that service is not influenced therefore by the acts of a corporate individual, nor are the investors known in the relationship of Company and Public, except as the operating executives and employees may be holders of its securities.

The employee body has assisted in many ways in the utility organization. They have actively participated in public relations programs, and in the past few years the practice has been growing to weave them into the solid foundation of commercial relations, the only base for building sound superstructures in any undertaking.

Good will in business has been defined as the desire of a person to return to the place where satisfaction in contractual relations has been given. It may be in selling or in any other contact. In the case of the buyer of kilowatt-hours, there is but one place to return over and over again, whether the "place" is good, bad or indifferent. That makes it the more important that the customer be satisfied with every contact in connection with transactions for electric service. It is likewise to the utility's advantage to have the greatest number of customers have friendly contact.

The electric utility is selling something that the customer *needs* and will want when properly sold. The reasons for not buying "full use" of electric service are numerous. It is the job of the company to explore them all. As Jimmy Durante would say, this is a "colossal" task. That is quite true unless the commercial forces are adequate to contact *all* customers.

A study of the monthly statements of many utilities reveals a certain percentage in each one that are in the "unprofitable" class from the company's viewpoint, because they did not pay enough to yield even a fair return on investment. But most of this same class use current "unprofitably" to themselves also, because they could use one or more of the electric services economically such as refrigeration, cleaning, washing, ironing and cooking, assuming the proper promotional rate construction exists and they are sold on the value of the service. Someone must sit down with each customer, talk it over and tell the customer the how and why.

Of course, "low income" does govern purchase of appliances and limit the use of energy, but the percentage in this class is smaller than we may expect. There is many a house which from outward appearances the salesman for a refrigerator or range or vacuum cleaner would pass by as *out*, were it not for the car standing outside. It had to be paid for, and probably the gasoline bill exceeds the electric bill, if any. Extra pennies were found somewhere to pay.

Beside the customers in the very low income group there are the procrastinating class of "moderate" users that can readily pay for products that will give additional wanted services, and who *expect to invest later*. They have read the advertising, attended exhibits, praised their neighbors' purchase, perhaps they have read much of the Federal Housing propaganda on low cost credit and how easy it is to pay, but they never have arrived at the point of decision where a name is signed on the dotted line. A good salesman has not sat down in the home to talk it over.

And we could add the class that made an investment in an electric device and then have not been sold on the value of the service. This includes the customer who found it a "bother" to connect the vacuum cleaner; whose maid is afraid of the washing machine and will not use it; the customer who shuts off the refrigerator in winter, and the one who does not use the range because it costs too much for repairs. We could increase the list by references to adjustment divisions.

Where are these potential customers for more business? How can the commercial department contact them all? It is a tough problem in the Metropolitan centers where even a large selling force can cover comparatively few prospects. A permanent force of several hundred of *trained* sales people, as those who call on utility customers should be, would produce staggering budgets, but perhaps justifiably so if the first shock to executives could be hurdled.

It is gratifying to find executives of the utility companies today seeing eye to eye as never before with the executives responsible for load building. But the lesson must still be taught that the way to greater profits in order to discharge the heavy expense burdens that the utility must carry today and tomorrow, is greater use of kilowatt-hours by present customers and those yet to be connected, and at lower average prices. That is a problem of investment efficiency. It takes man power, and greater promotional force than ever before in the history of the industry, to put it over. It can be done—it will be done.

Now, what standby sales help is there available to be mustered in for special offensives? Just recently there was a campaign in my home town for the Community Chest. A "campaign" means aggressive selling with large selling forces. It is a temporary movement rather than sustained. A great many people had to be seen in this charity campaign that were on the previous list of givers, and as many others as required to gain the total goal. The regular soliciting forces of those organizations were not enough. Therefore public-spirited citizens having an interest in the town, in addition to those working in it, were mobilized for action. The job was done by man power and woman power, contacting individuals and presenting a story. Hundreds who never gave to charities, and who felt they could not do so, were added to the list of contributors.

Again my local church had its budget planned, and it exceeded the funds in sight to meet requirements. The budget was not revised downward, but ways and means were planned to get the money. Direct-by-mail appeals and the usual calls by the regular officials produced partial results only. It needed more man power. So the town was districted and the force of men of the parish was organized to contact everyone "connected" with the church, to tell and

sell its needs. These men were not salesmen by profession. They were clerks, executives, engineers and what-not interested in a cause. Result: many people gave that had never contributed before and others raised the usual ante. Effective man power got results.

This mobilization of the entire organization of those having an interest in it to achieve a goal has been a successful practice in industry. It has been tried on many occasions in the electrical industry by manufacturer and utility. There can be no more interested group than the men and women who are gainfully employed in the organization. They may not be salespeople by profession, but there they stand as a "reserve force" which can be effective if properly trained and inspired. Perhaps the most effective way of doing this is an appeal to selfish interest.

The practice of *employee selling* where the entire force on the pay roll have been joined into the selling and promotional plans of the utility for their personal gain, directly or indirectly, has been more widely applied as the utility has felt the pinch of an emergency brought about by narrowing profit and rapidly mounting expenses.

One large utility company just closed a million dollar campaign among its employees. The groups outside the regular selling force were responsible for sales of merchandise totaling approximately $700,000. It is of interest that all employees purchased at special prices and terms approximately $300,000 worth of equipment for themselves. Another large company is just closing a three-months' campaign which started last October 1st. Up to December 2nd, 972 sales had been made and 4261 leads for more business had been produced.

In a recent survey among 172 utility companies there were 165 that had enlisted the help of employees in business-getting activity. Of that number, 91 enlisted them for direct selling and 74 for obtaining "leads" only.

Their selling policy varied. For example, three companies allowed employees to sell incandescent lamps, and confined commercial employee activity on other appliances to *leads* only. Thirteen companies allowed employees to *sell* small appliances, but they obtained *leads* on the major load builders. Nine encouraged employees help only on occasional campaigns.

As one might expect, the participation of employees in sales of promotional activities was a *voluntary* gesture on their part in more than 90 per cent of companies answering the questionnaire. In a few instances it was considered a *regular* duty.

The most popular method applied for interesting and enthusing the volunteers outside of the selling forces was a bonus or commission for sales or leads. Among the cases investigated, this method obtained in approximately 60 per cent of the cases; another 30 per cent used prizes and trophies and approximately 10 per cent depended upon the loyalty appeal.

The survey would indicate that about 63 per cent of those engaging in promotional activity through employees do so on a continuous basis, while others prefer the activity to be intermittent.

Of particular interest is the employee reaction to company request for assistance in the commercial progress of the company. Out of 164 companies answering this question there were 73 (44%) whose reaction was generally favorable or even enthusiastic. In 41 others (25%) the employees were passive. There was a negligible number expressing any specific opposition to participation.

The only exemptions from employee sales plans indicated were laborers and executive department heads.

The commission basis of payment appears most popular. In fact it was in the ratio of six to one over the bonus plan. One company reported using prizes only as a means of compensation. Still another company made the stipulation that the commission was applicable to the purchase of any electric appliance.

Among the 91 companies using employees for selling, there were 14 that used a full-time manager to promote this phase of commercial development. The balance used the regular sales managers to handle the job. It is to be noted that where a full-time manager is employed he contacts the employees direct.

The most popular method of promoting enthusiasm was the organization of teams, pitching one team against the other or one department against another. Inter-district contests were also popular.

In summing up the advantages or disadvantages of employee selling we may be guided most reliably by those who have had widest experience in mobilizing the reserve selling and promotional forces on the pay roll of the company. We asked these companies if they intended to continue such activities regularly in the future and 148 out of 164 making a reply to this specific question answered "Yes." This is not surprising because so many companies reported productive results especially in increased sales of appliances and increased load added to the lines. In one company in which the employees have been well knit into a selling organization, these additional sales have accounted for 50 per cent of the total.

If the job is to be done at all it should be done well. Naturally, the advisability of having trained group leaders depends on the size of the property and local conditions, but a majority of the companies think that it is necessary, or at least desirable, to train men for this particular leadership.

We have been through a period of staggering unemployment problems in numerous industries and we are not by any means out of the woods. Unfortunately in the ranks of the unemployed there are comparatively few salesmen. Selling is the basis of progress in business building, and in the utility industry in particular, too many companies have always been niggardly in the number of salesmen added to the pay roll. We may point to the handicap of the cost of training, and the difficulty of holding the salesman after he is well trained, because bidding for man power is keen in the field of selling.

In the ranks of utility employees that daily report on the job for other tasks, there are those who never attempted to qualify for selling, and yet whose interest, and need of additional compensation, makes them willing candidates to visit consumers and try to sell and assist for the benefit of the company with which they have cast their lot, and for their personal gain. Many of them have spare time after hours to devote to this additional service. Why not use the employee? After he is sold on the need of everyone's pulling an oar, then give him additional compensation for his productive results.

It may pay the commercial executive to study this potential sales power. We cannot line up too large an army in the kilowatt-hour parade.

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420 Lexington Ave., New York, N. Y.

# Standardization—Its Scope and Limitations

**By Howard P. Seelye**

*The Detroit Edison Company*

A paper presented at the meeting of the Transmission and Distribution Committee, Chicago, Ill., Oct. 9, 1935

STANDARDIZATION is a subject with which everyone is more or less familiar. The advantages to be gained by setting up definite standards of rating, quality and sizes for materials and equipment are almost obvious and are well recognized. It is also well known that the Edison Electric Institute and its predecessor, the N.E.L.A., have been agencies of standardization and that the technical committees, such as the Transmission and Distribution Committee, are interested in the formulation of standards. There probably are a number of members who are not entirely clear on just where the work of this committee and of the E.E.I. fits in with the very large program of national standardization which is going on, and what the policy of our organization is toward the development of standards. There also is evident a good deal of confusion of ideas on what constitutes a standard and how far it is practicable to go in such work. Opinions range all the way from the one extreme that standards are, in general, objectionable as impediments to progress, to the other extreme that everything we use should be covered by a detailed standard. Somewhere in between there is, no doubt, a compromise which could be agreed upon as a proper working basis. It is the purpose of this paper to attempt to clarify the situation somewhat by first reviewing briefly the relationship which has been established between the E.E.I. and other standardizing agencies, and the Institute's announced policy toward standardization, and then discussing some of the more important phases of the work of standardization in general, and of this committee in particular.

### Agencies of Standardization

While prior to 1918 there had been a considerable amount of standardization work done by various industries, national societies and the Government, there had been no concerted movement toward cooperative standards of a national character. In that year, the necessity for coordination of effort being recognized, the American Engineering Standards Committee was set up as a joint activity of the four large national engineering societies, American Institute of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, and American Institute of Mining and Metallurgical Engineers, together with the American Society for Testing Materials. The purpose of this organization was to establish as authentic American Standards such standards as could be agreed upon by the various interests represented. The membership and scope of this A.E.S.C. was broadened from time to time to include other national societies, trade associations and Departments of the Federal Government. In 1928 this was reorganized and the name changed to the American Standards Association. Its membership at present consists of 32 national technical societies and trade associations and seven Federal Government departments with 13 associate members. About 475 such bodies and 100 individual companies are actively participating in its work, with some 2700 official representatives from all branches of industry. About 300 standards have been officially approved and issued as American Standards and a large number are under preparation. The importance and magnitude of this movement and the results which already have been accomplished may be somewhat surprising to those who have not been closely connected with it.

It is the avowed intention of the American Standards Association that any standard given sanction as an American Standard shall represent a real national consensus of opinion. Projects are sponsored by individual members or groups of members, but representation of all interests which are concerned is included on the working committees. Since there is no central authority to enforce the use of any standards, their effectiveness depends entirely on their being acceptable to the manufacturers and users and on their being voluntarily adopted by them.

Naturally, there still exists considerable confusion in the use of standards. Many standards that have been issued under the name of such organizations as A.S.T.M., A.I.E.E. and others are being used in the industry, whether or not they have been adopted by A.S.A. Proposed new standards are continually being formulated by various organizations, and used on a tentative basis. In some cases these will be later presented to A.S.A., in others they are of such special nature that their identity with their sponsor will be retained, at least for some time to come. Eventually, this confusion may be largely eliminated when and if American Standards can be agreed upon for most of the materials which should be standardized. There is a possible danger that in some cases it will be attempted to carry the work too far into details which might better be left alone. There is also the danger that the individual organizations may assert their individuality too much in issuing their own standards in competition with A.S.A. It is to be hoped for the good which this work can do that these pitfalls may be avoided.

### Policy of the E.E.I.

The Edison Electric Institute is a member of the A.S.A. and as such is represented on all projects with which it is concerned. In 1926 a Committee on Codes and Standards was set up as part of the national organization of the N.E.L.A. and this is being continued under the E.E.I. Its purpose is "to formulate principles and practices for the guidance of all committees of the Association and all individual representatives of the Association engaged in activities related to Codes and Standards." In 1927 this committee issued a report setting forth the principles which should govern standardization work and outlining the relations between itself, the Institute office staff, official representatives on standardizing bodies, and the various technical committees. In brief this report says that:

(a) The Codes and Standards Committee

is to determine and direct all questions of policy, recommend appointments of representatives on standardizing bodies, and act as clearing house for all such activities.

(b) The Institute office staff is directed to keep contact with all important standardizing agencies and representatives thereon, distributing information to the proper committees or to members of the Association and obtaining the industry's reaction on important questions.

(c) Representatives on standardizing bodies are to be officially appointed by the President of the Institute and be responsible to the Codes and Standards Committee.

(d) Representatives on working committees actually preparing codes and standards are to be official and responsible to the appropriate National technical committee, and these in turn to the Codes and Standards Committee.

In connection with this subject the Executive Committee of the Engineering National Section passed a resolution in 1928 to the effect that "the N.E.L.A. should not publish specifications as standards of the Association—but—committees may publish specifications as recommended practice—. When American standards are available, N.E.L.A. specifications shall be automatically superseded." This policy is still in effect. It should be noted, however, that tentative standards or recommended practices are likely to assume the status of official standards in the minds of those not familiar with the exact nature of the relationships and policies which have been described unless considerable care is employed in their preparation and subsequent use.

The three principles set down in its report by the Codes and Standards Committee are important. They are:

"1. Codes and other collections of rules or regulations, when offered for promulgation as standards, *may enunciate principles* to which assent is given. They *should contain a minimum of quantitative requirements.* Detailed specifications are highly objectionable.

"2. Pure engineering standards, whether for dimensions, quality, or performance, are necessarily quantitative but *even these should preferably stress* the principles involved and *tend to avoid restrictive details.*

"3. Due regard should be had for economy. The burden of representation is heavy in time and money, and in order to keep this within bounds, efforts should be made to guide standardizing activities into the smallest number of channels practicable and otherwise to condense such activities."

These principles offer a good guide to action and should be remembered.

Some of the points brought out will be discussed more fully later.

### Scope of Transmission and Distribution Committee

The standardization work in the Transmission and Distribution Committee might be classified as follows:

1. To assist in projects being actually carried on by the A.S.A. This is done by maintaining contact with our representatives, furnishing information and recommendations when requested, and registering acceptance or protest on standards proposed for final adoption. Authority for action in these matters is not vested in this committee but in the Codes and Standards Committee.

2. To formulate suggested standards which are acceptable to our own industry. These may be published as recommended practice only, or, if suitable, may be proposed, through the proper channels, to A.S.A. for consideration as American Standards. Under the existing policies of the E.E.I., Standards will not be issued as such, however.

3. To assemble information on what may be considered good practice in fields where definite standardization is not feasible, at least at this time.

4. To encourage the general use of standards which have been adopted. Also to encourage concentration of usage in any other class of material which seems suitable for standardization, in order to make standardization possible.

The dividing line between the second and third classifications, that is, between standards and good practice which is not subject to standardization, is not well defined. It would be helpful to get a clear idea as to just what constitutes a standard, what materials are or are not subject to standardization and why, and how far should the standardization of any item be carried. To answer these questions will require a little discussion of the nature of standards and the different forms standardization may take.

### Definition and Types of Standards.

A standard is defined as "any measure of extent, quantity, or value established by law or by general usage or consent." The first part of this definition suggests the scope of standardization, that is the general attributes of a material or an article or its use which are subject to being standardized. This may be expanded, as indicated in the A.S.A. Yearbook for 1928, as follows:

1. *Nomenclature*—This includes definition of terms, abbreviations, and symbols and also the assignment of suitable and distinctive names to articles not clearly designated by common usage.

2. *Quality Specifications* for materials and equipment. The composition, source, process of manufacture, appearance, finish, allowable defects, strength and performance of any piece of equipment or its component parts are included in this class.

3. *Methods of Test*—Test procedure by which quality requirements can be determined.

4. *Ratings*—This includes ratings of machinery and apparatus which establish limits for test or operation, such as voltage or current ratings. It might also include the establishment of accepted values for inherent qualities of materials, such as the unit breaking strength of timber.

5. *Uniformity of Dimensions*—For interchangeability of parts and the interworking of apparatus, certain dimensions, at least, must be uniform or coordinated.

6. *Simplification of Variety*—Concentration upon the fewest possible number of sizes, types, or grades of any product.

7. *Provisions for Safety*—The National Electrical Safety Code is a good example.

8. *Rules for Operation*—This applies to rules for assembling, setting up, and operating apparatus. Such rules are usually confined to individual plants.

A standard for any item of equipment might include consideration of all these classes. Those numbered from 2 to 6 are quite frequently all specified. In fact, the idea seems to be sometimes held that a standard specification *must* include all of these points. This is not necessarily true. Such a specification as that is a very restrictive one. The more restrictive it is, the harder it is to get agreement upon it by diverse groups of users. Broader specifications are often more feasible.

### Quality Standards.

The items 2, 3, and 4, that is, Quality, Tests, and Ratings, may be included under a general heading of Quality Standards. Items 5 and 6 come under the class of Dimensional Standards. Quality Standards are much broader than Dimensional Standards and, hence, it is easier to get agreement on them, although even this is hard enough, as those who have worked on some of the committees well know. The average user is usually somewhat hazy as to what he should ask for in regard to the composition, finish, or allowable defects of the material he is buying, and must depend upon an accumulated fund of research and experience of himself and others and the practical knowledge of the manufacturers to tell him. It is safe to say that the greatest demand for national standards is for this type and the majority of the American Standards already issued by A.S.A. are in the quality class. The principles enunciated by our Code and Standards Committee point to the desirability of directing the greatest amount of effort toward such standards.

### Dimensional Standards

The Dimensional type of standard is narrower. Here the user is more likely to have definite ideas of just what he wants for his own purpose and is less willing to concede to others. Naturally, there are some dimensional standards which are almost essential. For example, bolt threads should be thoroughly stand-

ardized. A considerable loss in dollars can be occasioned by the confusion in hunting for the right nut to fit a particular bolt which is not like any other bolt. If insulator manufacturers do not all use the same type of thread and pin manufacturers have still other ideas, dollars are lost by the user in trying to fit his insulators to his pins. On the other hand, where interchangeability is not a factor, it is frequently hard for a user to see why he should give up his ideas of what he likes best unless there is an advantage in cost. Standardization and simplification of dimensions on a national scale is usually of advantage to the manufacturers, although it is not always possible to reflect this advantage into price reductions to customers to an extent which will be attractive. In such a case it is very difficult to get any very restrictive standards accepted and it may be seriously questioned as to whether it is worth while to go very far in attempting to set them up.

### General Usage an Essential

Referring to the definition of a standard which has been previously given, it is evident that the outstanding requirement is that it must be "established by law or by general usage or consent." This work might be easier if we could use the law to enforce the results, although it is doubtful if the reactions of industry in that case would be all that would be desired. "General usage" should be emphasized as being essential to a standard. Even consent is not enough, as witness the fact that the Overhead Systems Committee approved 53 tentative standards of line hardware which had been consented to by the committee but it is doubtful if many operating companies are using more than half of them. There is no authority to enforce any standard on a national scale, hence, if it is not endorsed by general consent *and* usage, it cannot be called a standard. It is believed that this should mean that the standard, in order to be classified as such, should be used in the established form by something like 80 per cent of the users of such equipment. If not, it is not a standard and will not be unless it can be broadened to acquire general use.

### Standards and Good Practice

The whole field of good practice includes, of course, a good many practices which border on standards, even though not of that status. Such a classification as the following might be made:

1. *Accepted standards*—standards which have been adopted by consent and usage.
2. *Tentative standards*—standards which probably will be accepted after a period of trial and revision.
3. *Suggested standards*—standards which are seriously believed to merit acceptance after due consideration of all interests but which have only had limited study as yet.
4. *Temporary standards*—standards which may be fairly well accepted for the time being but are expected to require major changes in the not too distant future.
5. *Good Practice*—cases in which a variety of items have almost equal acceptance but cannot yet be grouped or simplified into fixed standards. Equipment which is in a development period falls in this class. Little is to be gained by attempting to force a standard where there is no evidence of a general concentration of favor on one or more items, or where frequent changes and new designs are expected.
6. *Individual Ideas*—Some of these may be good but have only limited use. Any standardization is rather obviously foolish unless its use becomes general. A good many patented articles are in this class. As a rule patented articles should not be endorsed as a standard for commercial reasons.

It would be well to keep these distinctions in mind in order to avoid confusion in this work. There can be no objections to publishing examples of good practice if they are distinguished as such. They should not be termed as standards, or even suggested standards, unless and until they are indicated by common favor as belonging in that class.

### Intra-Company and Inter-Company Standardization

It is not always recognized that there is a very marked difference in the scope of standardization as applied to an individual operating company and standardization for an industry at large. Within a single organization there is every reason to carry standardization to the limit. The work can be closely controlled, with facilities for setting up or changing detailed standards readily to meet changing conditions. Furthermore, there is authority to adopt and enforce standards. Economy is evident, even in relatively small items, when carefully studied standards are adhered to throughout the organization. The scope of such standardization includes Nomenclature, Quality Standards, Dimensional Standards, and Rules. National standards should be used where they can be applied, but there should be no hesitation in establishing company standards where they do not, even down to the smallest dimensional details and the most rigorous simplification of types and sizes.

The field of inter-company standardization is much more restricted. The difficulties encountered in trying to reach a common agreement on details, which are sometimes serious even in one's own organization, are multiplied when it is attempted to include other companies or groups which have their own established practices and ideas of what is best. Authority to force agreement and acceptance is entirely lacking. The incentive of economy becomes much less. If a company is large enough to buy in relatively large quantities, as a good many of us are, there will be little if any difference in the prices quoted on a general standard and on a special design of the same general type. There is, therefore, little incentive for the Commonwealth Edison Company, for example, to adopt a Detroit Edison bracket if they have one they like better and vice versa, since the price on carload lots might be about the same. The manufacturer might be a little better off if both could agree on the same one but perhaps not enough to make an attractive price differential. There is sometimes a temptation to show the crusader spirit and try to get one's own ideas adopted as standard whether other people like them or not, but such standards obviously do not get very far. The answer is, undoubtedly, to carry the national standardization of any item only so far as will be generally acceptable. This may mean a quality of standard only or it may include some dimensional standardization, such as a range of acceptable sizes, or certain basic dimensions. A good deal of wasted effort can be avoided if the proper place to stop can only be recognized.

It is entirely feasible, of course, for a trade association to set up certain standards in which it is peculiarly interested and which would be of no interest to the industry at large. As an extreme example, I understand the meat packers' association has standards in regards to quality and packing of pigs' feet which are pretty much their own affair. As far as this committee is concerned, the establishment of any E.E.I. Standards as such is against the policy of the organization. If suggested standards are formulated, it would seem advisable that they be of such a nature that they can eventually be suggested to the A.S.A. for adoption as American Standards. Other materials which it seems advisable to present to our members for assistance in their own company work or perhaps in order to influence the trend toward the point where standards are

feasible might well be covered by good practice suggestions rather than attempting to include them in a standardization program.

### Economy the Test

In the long run, there appears to be only one basic reason for standardization work. That reason is economy. A number of supplementary advantages may come to mind, such as obtaining better and more uniform quality, simplification of buying and handling, and the convenience of having an established and recognized good practice for reference and as a basis for design. These are all essentially matters of cost, however, as well as the more obvious cost advantage of lower price due to larger and simplified production. The test of any proposed project should be simple, therefore —"Will it result in a reduction in cost? If not, why undertake it?"

There is no reason for suggesting a standard if it does not meet the test of economy, or if it is of such a character that its general acceptance by consent and usage is not probable. By the same token, we should seriously oppose the official adoption of any standards sponsored by other interests if they do not meet our needs and have not the characteristics just mentioned, unless and until they can be broadened to fulfill these requirements.

### Summary

To summarize, the following points should be emphasized in connection with our work on standards and specifications:

1. A standard is only a real standard if it is endorsed both by consent and also by usage by the large majority of the industry. Standards cannot be forced.

2. National standards should be restrictive only to a point which will be helpful and acceptable to the users. Quality standards alone may be all that is necessary or desirable, in most cases. Dimensional standards are narrower and should be set up only when a real need is evident.

3. The wide field of intra-company standardization should not be confused with the narrower field of inter-company standardization.

4. The nomenclature used in this work by the Transmission and Distribution Committee should be given careful consideration to avoid confusion between suggested standards and good-practice recommendations.

It is at present contrary to E.E.I. policy to set up E.E.I. standards directly or by inference.

5. Any standardization project should promise eventual economy in order to be worth while.

There is still much to be done in standardization work on materials and equipment, both in connection with national standards and in the promotion of good practice among ourselves.

It is believed that a clear conception of the distinctions which it has been attempted to bring out in this paper will help in directing our energies where they will do the most good and in avoiding wasted effort.

Reference: "Industrial Standardization." Published by National Industrial Conference Board.

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*Arkansas Utilities Association meets in Convention at Hot Springs*

THE 25th annual convention of the Arkansas Utilities Association, held at Hot Springs, November 25-26, was acclaimed as the most successful in the history of the Association. A. G. Whidden, Director of Advertising, Arkansas Power and Light Company, was elected President of the Association to succeed W. S. Van Sickel, of the Oklahoma Gas and Electric Company.

Speakers at the Convention included Harvey C. Couch, Arkansas Power and Light Company; J. F. Owens, Oklahoma Gas and Electric Company; W. S. Van Sickel, Oklahoma Gas and Electric Company; Bernard F. Weadock, Edison Electric Institute; P. A. Lasley, State (Arkansas) Department of Public Utilities; C. F. Byrns, *Southwest-Times Record* (Fort Smith); Charles C. Fichtner, School of Business Administration, University of Arkansas; Edwin W. Vennard, Middle West Utilities Company; Dr. Gus W. Dyer, Vanderbilt University; W. G. Givens, Arkansas Power and Light Company; C. B. Wilson, Little Rock Gas and Fuel Company and Whit Morgan, Assistant to Com. of Revenues, Little Rock.

*McGraw Prize Paper*

# The Stability of Interconnected Electric Power Systems

**By Mowton Le Compte Waring**

THE interconnection of large power systems and the development of water power resources frequently involve the transfer of large blocks of power over long distances. That there are limits to the amount of power that can be transferred over a given transmission circuit has been well known, but it is only in recent years that adequate methods for analyzing the transient or steady-state behavior of such interconnections have been made available. Numerous articles and papers treating this subject have been presented, but either because of their highly technical nature or because of their intentionally limited scope, they are referred to largely by those well versed in the subject.

Since stability or power limitations must receive consideration in the planning and operation of many systems, it is unquestionably desirable that those engaged in these activities have a basic understanding of the limitations imposed by instability and of the relative merits of the various means by which these limitations can be minimized. It is the purpose of this paper to discuss these various means and to present sufficient physical theory that those not already familiar with the subject may be enabled to comprehend the fundamentals involved.

MR. WARING

*Mr. Waring is the winner of the Third James H. McGraw Prize for 1935. He is employed in the System Planning Bureau of The New York Edison Company.*

*Mr. Waring graduated from the Virginia Military Institute in 1927 with the degree of B.S. and in 1932 obtained the degree of M.S. in Electrical Engineering at Union College. He was formerly associated with the Central Station Engineering Department of the General Electric Company at Schenectady.*

### Steady-State and Transient Stability Limits

Instability or loss of stability is evidenced by a loss of synchronism between elements of interconnected synchronous apparatus. This loss of synchronism may occur simply between a generator and its synchronous load, or more complexly between two or more major groups of synchronous machines comprising a large interconnected power system. In general, such instability may be classified under two headings: steady-state and transient. The term steady-state refers to normal operation where there are no sudden changes in loading or system connections and instability is caused by slowly increasing the load transfer to a point where the synchronous elements no longer possess sufficient synchronizing power to remain in synchronism. The term, transient, refers to conditions immediately following and caused by some sudden abnormal disturbance or series of disturbances. Such disturbances may require a readjustment of the angular relations among the synchronous machine rotors. Here again, an insufficient transfer of synchronizing power will result in instability.

## STEADY-STATE STABILITY

### Machine Characteristics

The vector diagram of a salient pole synchronous machine is shown in Fig. 1a. Because of the non-uniform air gap around the rotor of such a machine, the magnetic reluctance of flux paths linking the machine circuits will vary in accordance with the relative angular position of the rotor circuits with respect to the revolving stator flux. However, all rotor circuits are symmetrical with two radial axes, one lying midway between the pole pieces and the other being coincident with the center line of the pole pieces. These are known, respectively, as the quadrature and direct axes. Because of this inherent symmetry in the design of present-day machines, it is possible to reduce salient-pole machine analysis to a relatively simple basis, commonly described as the Two-Reaction Theory. Thus each machine has two components of reactance (direct and quadrature axis synchronous reactance), two components of armature current (direct and quadrature axis armature current), etc. The significance of these values is best illustrated by reference to the vector diagram. Fig. 1a shows the effect of the unequally distributed magnetic reluctance of a salient-pole machine. In a cylindrical-rotor machine, such as a turbo-generator, the magnetic reluctance is substantially uniform and the voltage drop across the resultant synchronous reactance is at right angles to the armature current (see Fig. 1b). It is interesting to note that these vectors are perpendicular only in the case of the cylindrical rotor machine. Armature resistance is neglected for the sake of simplicity.

The electrical power input or output of a synchronous machine under steady-state conditions depends upon the machine angle, the terminal voltage and

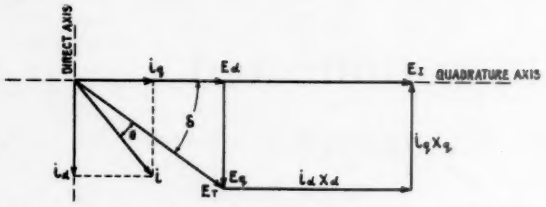


FIG. 1a—VECTOR DIAGRAM OF SALIENT-POLE SYNCHRONOUS MACHINE.

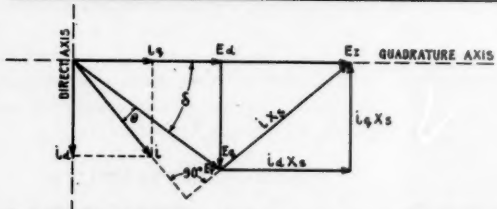


FIG. 1b—VECTOR DIAGRAM OF CYLINDRICAL-ROTOR SYNCHRONOUS MACHINE.

$E_T$ = TERMINAL VOLTAGE
$E_d$ = DIRECT AXIS COMPONENT OF TERMINAL VOLTAGE.
$E_q$ = QUAD. " " " " "
$i$ = ARMATURE CURRENT
$i_d$ = COMPONENT OF ARMATURE CURRENT PRODUCING MMF IN DIRECT AXIS.
$i_q$ = " " " " " " " QUAD.
$X_s$ = SYNCHRONOUS REACTANCE OF MACHINE.
$X_d$ = DIRECT AXIS COMPONENT OF SYNCHRONOUS REACTANCE.
$X_q$ = QUAD. " " " " "
$E_I$ = THE VOLTAGE INDUCED BY THE FIELD EXITATION — FREQUENTLY REFERRED TO AS THE VOLTAGE BACK OF SYNCHRONOUS REACTANCE.
$\delta$ = THE ANGLE BETWEEN $E_T$ AND $E_I$ — OFTEN CALLED THE LOAD OR DISPLACEMENT ANGLE.
$\theta$ = POWER FACTOR ANGLE

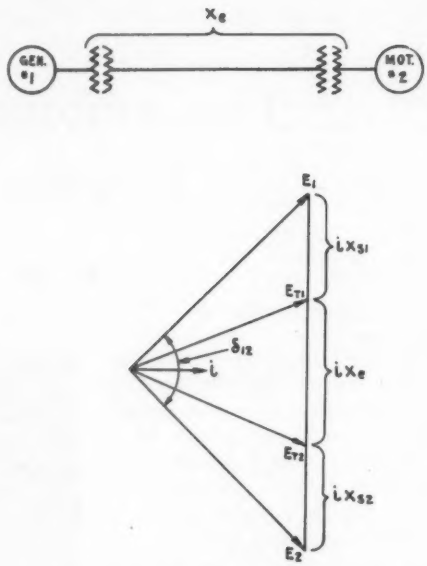


FIG. 2—VECTOR DIAGRAM OF TWO INTERCONNECTED SYNCHRONOUS MACHINES.

$\delta_{12}$ = DISPLACEMENT ANGLE OR ANGLE BETWEEN $E_1$ AND $E_2$.
$E_1$ = EXCITATION VOLTAGE OF GENERATOR
$E_2$ = " " " MOTOR
$E_{T1}$ = TERMINAL VOLTAGE OF GENERATOR
$E_{T2}$ = " " " MOTOR
$i$ = CURRENT
$X_{S1}$ = SYNCHRONOUS REACTANCE OF GENERATOR
$X_{S2}$ = " " " MOTOR
$X_e$ = REACTANCE OF TRANSMISSION CIRCUIT (EXTERNAL REACTANCE)

the excitation voltage (or "voltage behind synchronous reactance"). The general relation between these four variables in terms of the synchronous reactance may be expressed by the following fundamental equation (see Appendix A for derivation):

$$P = \frac{E_I E_T}{x_d} \sin \delta + E^2_T \frac{(x_d - x_q)}{2 x_d x_q} \sin 2\delta \quad (1)$$

The second term of this equation is not a function of the field excitation of the machine. Since it is caused by the difference in magnetic reluctance of the direct axis and of the quadrature axis, this component is called the reluctance power or torque. Thus a salient-pole machine will develop torque even though no excitation is applied ($E_I = 0$). Small motors of the reluctance type are actually built and develop their torque in this way. However, when $x_d = x_q$, as in the case of the cylindrical rotor machine, this component becomes zero and the power-angle equation becomes:

$$P = \frac{E_I E_T}{x_d} \sin \delta \quad (2)$$

### Power Transfer Between Two Interconnected Machines

When a system has but two cylindrical rotor synchronous machines, as for example one a motor and the other a generator connected by a transmission circuit of reactance $x_e$, the power transferred can be expressed by the following equation similar to (2) above:

$$P_1 = -P_2 = \frac{E_1 E_2}{x_T} \sin \delta_{12} \quad (3)$$

where the subscripts $_1$ and $_2$ refer to the motor and generator respectively and the reactance $x_T = x_{d_1} + x_{d_2} + x_e$. The vector diagram is shown in Fig. 2 and a curve of power versus machine angle for certain assumed operating conditions is shown in Fig. 3.

An examination of this latter figure shows that for any given values of excitation voltages and reactance ($E_1$, $E_2$, and $x_T$), any increase in mechanical power input to the generator rotor will result in an increase in the angular displacement between the rotors of the two machines. However, the rate of increase in power transfer will diminish and become zero when $\delta_{12} = 90$ degrees. This is the point of maximum power transfer. Any further increase in mechanical power input will further increase the angular displacement, but the power transfer will decrease. As a result the generator rotor will have acting upon it a net accelerating torque equal to the difference between the mechanical torque input and the electrical torque output, causing the rotor to increase its speed. Conversely, the motor will have less electrical torque input and will start to slow down. These actions will result in a further increase in angular displacement which will produce even greater accelerating and decelerating torques on the respective rotors. This process being cumulative, the system is unstable and the rotors will pull apart, losing synchronism with respect to each other.

### Possible Means for Increasing the Steady-State Power Limit

The maximum-power or steady-state power limit in the above case occurs when $\delta_{12} = 90$ degrees. Inspection of equation (3) reveals the following possible methods for increasing this limit:

(1) by reduction of machine reactances.
(2) by reduction of transmission circuit reactance.
(3) by increase in excitation voltages.

The synchronous reactance of a machine can be varied by changes in design. The average value for machines designed for use in the United States is about 100 per cent reactance. European

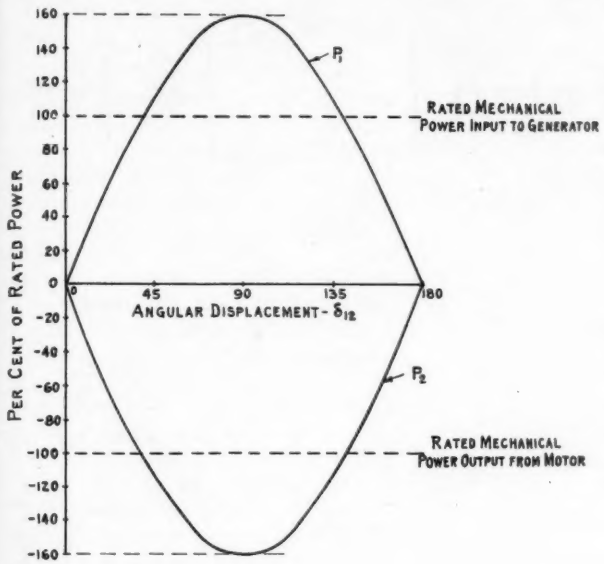


FIG. 3 - POWER-ANGLE CURVES OF MACHINES SHOWN IN FIG. 2.

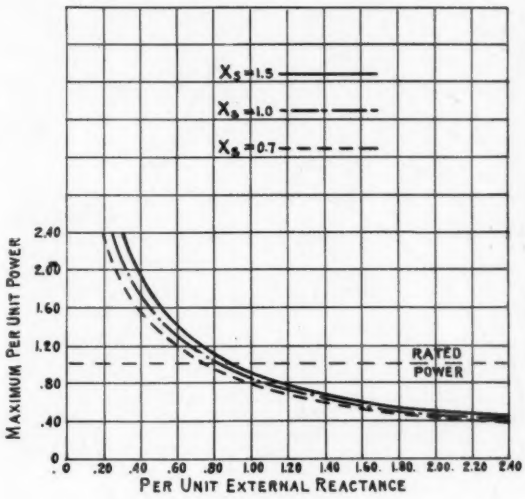


FIG. 4 - EFFECT OF CHANGE IN MACHINE SYNCHRONOUS REACTANCE AND EXTERNAL REACTANCE ON THE MAXIMUM POWER THAT CAN BE TRANSMITTED.

machines have, in general, a higher value. A machine having a low reactance is more expensive than a similar machine having a high value. When the external reactance ($x_e$) is small, any reduction in synchronous reactance will give a corresponding increase in the maximum power limit. However, in such cases the machines are closely coupled and the steady-state power limit is well above the rated capacity of the machines so that thermal rather than stability limitations are the ruling factors.

Conversely, when the external reactance must be large, a decrease in the machine reactances will offer a negligible or small gain in power limit. In Fig. 4 the particular case is illustrated where a synchronous generator is delivering power over a transmission circuit to an infinitely large system. The variation in steady-state power limit with change in the synchronous reactance for varying amounts of external reactance is shown. These curves also show the limiting values of external reactance that can be used for a given synchronous reactance under the assumed operating conditions at rated load.

A much greater increase in power limit can usually be obtained by decreasing the external reactance, i.e., the reactance of the transmission circuit, particularly when this reactance is large in comparison with the machine reactances. When the transmission circuit is long, the steady-state power limit may approach or in extreme cases be less than the rated capacity of the generator, in which case any means employed for decreasing the external reactance would be effective. This can be accomplished in several ways; the most effective being to install a high voltage transmission circuit or to provide several parallel circuits. For example, doubling the transmission circuit voltage will cut its equivalent reactance to one quarter. From time to time considerable attention has been given to the possible use of multiple or split-conductor circuits. A very appreciable reduction in line reactance can be obtained by this method. However, when the economical side is worked out, multiple conductors do not look so attractive. This is mainly because of the need for heavy towers, short spans, and special supporting and separating yokes.

A third possible method for increasing the steady-state power limit is by increasing or properly regulating the excitation voltages of the machines involved. Obviously, operating requirements prevent any appreciable increase in the machine terminal voltages. However, it is possible to operate the machines or system in so-called "dynamic stability." By way of illustration, take the example of two identical synchronous machines connected directly together. As explained above, the steady-state stability limit occurs when the load angle equals 90 deg. This power limit could be increased by increasing one or both of the machine excitation voltages, but with a resulting increase in the terminal voltage which is not permitted by operating requirements in a practical case. If the load angle is increased to a value greater than 90 deg. the terminal voltage will decrease, eventually becoming zero when the angle is increased to 180 deg. It is theoretically possible to maintain rated, terminal voltage with any higher values of excitation by increasing the load angle above 90 deg. Referring to Figure (5), the solid lines represent the power-angle curves of the two machines when their excitations are equal and adjusted to give rated terminal voltage when the load angle is 90 deg. The dotted lines represent the power-angle curves when the excitations are increased to a higher value. For this particular case the terminal voltage will be at rated value when the load angle equals 120 deg. At this angle, the power transfer is appreciably higher (73 per cent) than the steady-state stability limit.

Although in an unstable zone, the machines can be operated in dynamic stability at this point by the use of suitable voltage regulators on both machines. Any slight disturbance will cause the rotors to swing apart increasing the load angle and decreasing the terminal voltage. This drop in terminal voltage initiates the operation of the regulators which increase the excitation voltages. Because of the resulting increment in power transfer the load angle will decrease and the terminal voltage will increase until a second regulator operation is required to reduce the terminal voltage. This

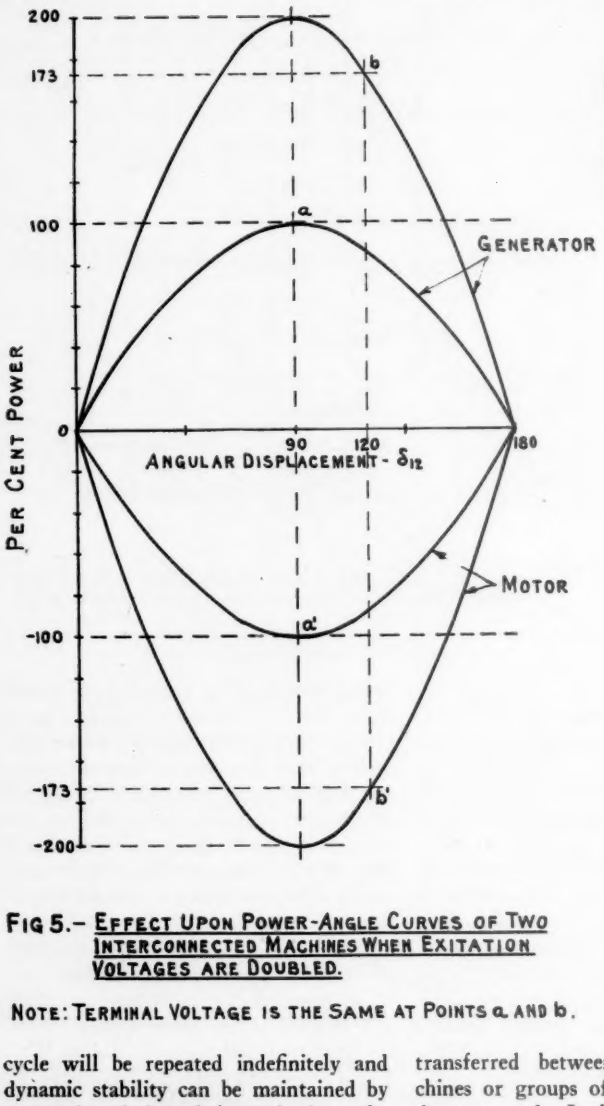


FIG 5.– EFFECT UPON POWER-ANGLE CURVES OF TWO INTERCONNECTED MACHINES WHEN EXITATION VOLTAGES ARE DOUBLED.

NOTE: TERMINAL VOLTAGE IS THE SAME AT POINTS a AND b.

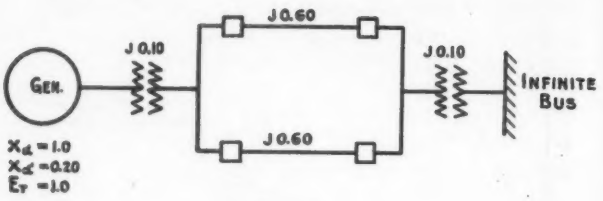


FIG. 6

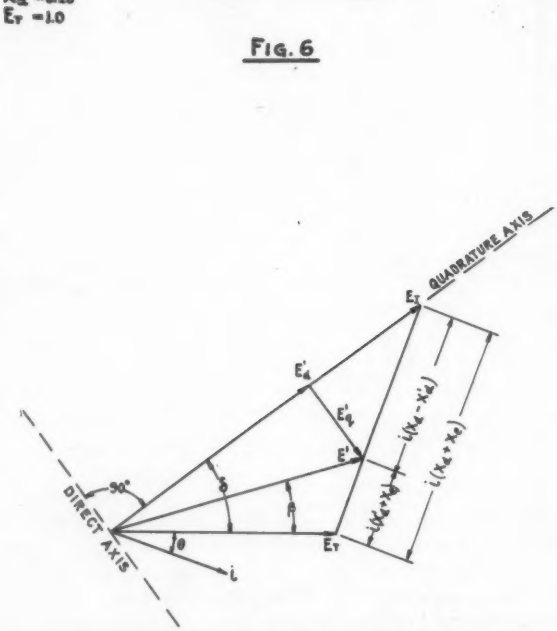


FIG. 7 – VECTOR DIAGRAM FOR STEADY-STATE CONDITIONS PRIOR TO TRIPPING ONE LINE IN FIG. 6.

NOMENCLATURE SAME AS IN FIG. 1 WITH FOLLOWING ADDITIONAL VECTORS:
$X'_d$ = TRANSIENT REACTANCE OF MACHINE.
$E'$ = EQUIVALENT VOLTAGE BACK OF TRANSIENT REACTANCE.
$E'_d$ AND $E'_q$ = DIRECT AND QUADRATURE AXIS COMPONENTS OF $E'$.
$X_e$ = EXTERNAL REACTANCE OF TRANSMISSION CIRCUIT (BOTH CIRCUITS CONNECTED IN.)

cycle will be repeated indefinitely and dynamic stability can be maintained by repeated variation of the excitation voltages.

A number of tests have been made in laboratories on small machines and remarkable gains in power limit have been shown when the terminals of the machines were connected directly together. When a transmission line is placed between them this gain is radically reduced and for long lines is of the order of 15 or 20 per cent above the steady-state limit. One important factor brought out by these tests is that for the average system equipped with dynamic regulators of the proper design, existing exciters of standard design have a sufficiently rapid rate of response to give successful results.

### Summary of Steady-State Stability Limits

That there is a steady-state limit to the amount of power which can be transferred between synchronous machines or groups of machines has been demonstrated. It should not be inferred that systems can be operated at this limit since any disturbance, such as might be occasioned by a switching operation or a load change could cause instability. Consequently, practical systems must operate with loadings definitely less than those corresponding to this limit. Furthermore, in the majority of systems, the transient stability limit will be less than the steady-state, so that a system which is stable under transient conditions caused by system faults will commonly be stable when steady-state conditions are again reached. It is probable, therefore, that in most cases the steady-state stability limit of a system will be largely of theoretical interest. Occasions may arise, however, where interruptions of service caused by transient instability can be tolerated, in which cases the steady-state stability limit would be the deciding factor. In such instances as well as in the infrequent cases where the steady-state limits are lower than the transient, means for increasing these limits are important.

Since the steady-state power limit becomes of importance only when the machines or machine groups are connected by relatively long transmission circuits, there are only two effective stability aids. These are first, by the reduction of the transmission circuit impedance and second, by operation in dynamic stability at higher excitation voltages. The first of these aids requires a large investment in transmission equipment, while the successful operation of the second depends upon the reliability of the machine voltage regulators. Either means has its proper field of application and, although other methods for increasing the steady-state stability limit have been and will be proposed, they are the most obvious and presumably the most effective.

## TRANSIENT STABILITY

### Machine Characteristics

The preceding discussion has been devoted to the behavior of synchronous machines when subjected to a very slow change in load. During the transients resulting from some sudden system disturbance their behavior changes radically. In order to illustrate the fundamental principles involved the simple case shown in Fig. 6 will be considered. This consists of a cylindrical-rotor generator connected to an infinitely large system by two parallel transmission circuits. The machine is operating at full load and normal voltage when one of the line breakers is suddenly tripped. The entire electrical power output must be fed over the one remaining circuit. This is equivalent to suddenly increasing the amount of external reactance between the machine terminals and the infinite bus. The vector diagram for steady-state conditions prior to tripping one of the line breakers is given in Fig. 7.

At the instant one of the connecting lines is tripped out, there will be a change in the current and voltages represented by the vector diagram of Fig. 7. A corollary of Lenz's Law known as the Constant Linkage theorem can be stated as follows:

In any closed circuit containing no resistance, the flux linking that circuit will remain constant during any change in the currents or voltages of the other circuits to which it is magnetically coupled. Actually, all inductive circuits also contain resistance, and current flowing through this resistance produces a loss which is dissipated as heat. The energy loss must be supplied by the magnetic field so that actually the flux linkages will decay with time.

In accordance with this theorem there can be no instantaneous change in the amount of flux linking the rotor circuits in either the direct or quadrature axes. Consequently, neither $E'_d$ nor $E'_q$ (corresponding to these linkages) can change at the first instant. Since neither of its components can change, $E'$ must remain fixed in magnitude. Furthermore, the rotor has inertia and cannot move instantaneously with respect to the infinite bus so that $E'$ is also fixed in angular position. Knowing these facts and having assumed that the infinite bus voltage ($E_T$) is fixed in magnitude and direction, the vector diagram of Fig. 8 can be drawn representing the current and voltages at the first instant after the line is tripped.

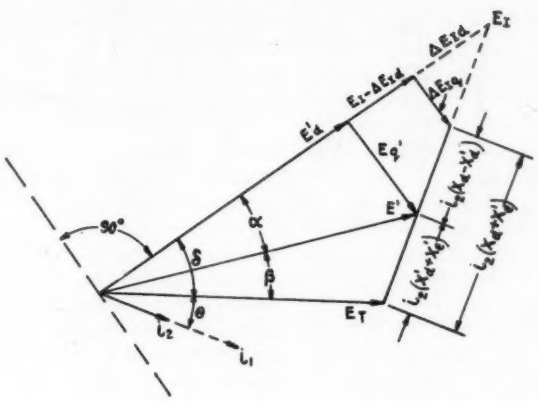


FIG. 8 – VECTOR DIAGRAM FOR TRANSIENT CONDITIONS IMMEDIATELY AFTER TRIPPING ONE LINE IN FIG. 6.

$X'_e$ = EXTERNAL REACTANCE OF TRANSMISSION CIRCUIT (WITH ONE LINE SWITCHED OUT.)

The power received by the infinite bus, at the first instant after the line is switched out and as long as $E'$ remains constant, is (see Appendix B for derivation):

$$P = \frac{E'E_T}{x'_d + x'_e} \sin(\delta - \alpha) \qquad (4)$$

This is the equation of the transient power-angle characteristic of a synchronous machine and is similar in form to equation (3) for steady-state conditions. As long as constant flux-linkages are maintained, the only two variables are the power output and the load angle.

When studying the transient stability characteristics of a synchronous machine, the assumption is frequently made that the flux linkages in the machine remain constant. For the short periods of time normally considered in a stability calculation, this assumption is often justifiable. In the following analysis such an assumption will be made.

### Power Transfer Between Synchronous Machines under Transient Conditions

Equations (3) and (4) are plotted in Fig. 9 for the case shown in Fig. 6, assuming that the field excitation of the generator is initially adjusted to give unity power factor current at rated load and terminal voltage. The machine is first operating at point (*a*) on the

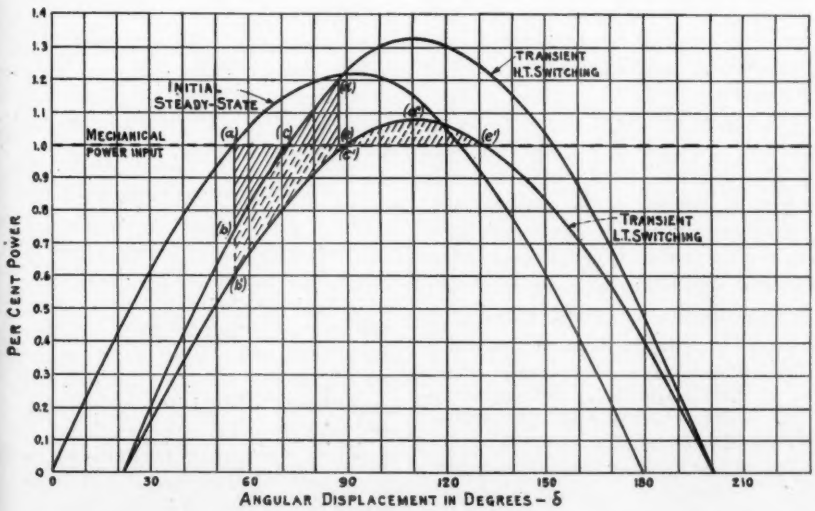


FIG. 9 – STEADY-STATE AND TRANSIENT POWER-ANGLE CURVES OF SYSTEMS SHOWN IN FIGS. 6 AND 10.

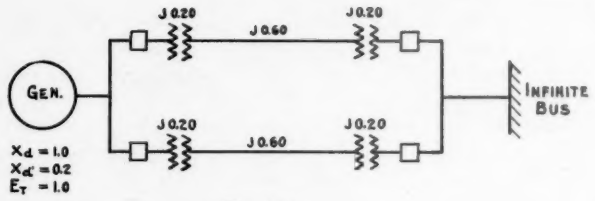


FIG. 10

steady-state power-angle curve. At this point the mechanical power or torque input to the rotor is equal to the electrical power output (neglecting losses). At the instant one line is switched out, the electrical power output will drop to point (*b*) on the transient power-angle curve.

At point (*b*) there is a net difference between the mechanical torque input and the electrical torque output which tends to accelerate the machine rotor. The rotor has inertia and absorbs kinetic energy as it swings to a larger angle. While the load angle increases, the electrical power output increases as shown by the transient power-angle curve. When the rotor reaches point (*c*) the input and output torques are again equal. From point (*b*) to (*c*) the torque acting on the rotor is accelerating it and the maximum rotor velocity is attained at (*c*). Because of the kinetic energy absorbed during this period, the rotor will continue to swing on beyond the point (*c*). Then the torque output begins to exceed the torque input and the net difference tends to decelerate or brake the rotor. Instead of receiving energy from an excess mechanical input the rotor is now delivering excess electric energy to the system and continues to do so until point (*d*) is reached. The point (*d*) must be situated so that as much kinetic energy will have been delivered by the rotor to the system during its travel from point (*c*) to point (*d*) as the rotor received from the prime mover during its travel from (*b*) to (*c*). This condition will exist when the area (*a b c*) equals the area (*c d e*).

At point (*d*) there is again an unbalance in torques and the rotor will decelerate or slow down to point (*b*), completing one cycle. The rotor will continue to oscillate back and forth indefinitely between points (*b*) and (*d*) unless damped out by the action of an amortisseur or other rotor circuits. As long as the flux linkages remain constant, the machine will not lose synchronism and is therefore stable for the first part of the oscillation.

The case shown in Fig. 10 has been selected to illustrate an unstable system under transient conditions. The only difference between Fig. 10 and Fig. 6 is that low-tension rather than high-tension bussing is used. As a result the effective value of reactance inserted between the machine and the infinite bus (when switching out a line) is greater in the second case. The transient power-angle curve for this case is also plotted in Fig. 9. The steady-state power-angle curve applies to either case. Obviously, the area ($c'$ $d'$ $e'$) can never equal the area ($a$ $b'$ $c'$) so that there is insufficient restoring force to prevent the machine rotor from swinging out of synchronism.

### Causes of Transient Instability and Means for Minimizing Their Effects

Since transient instability is caused by system disturbances, any means whereby these disturbances can be avoided or minimized will produce gains in transient stability limits. There are many types of system disturbances and even more possible means for minimizing their effect. The following is a general discussion of these factors. The soundness of such a generalization may be questionable, as factors which are beneficial in one case may be detrimental in another. However, the effect of some particular stability aid upon a specific system will usually be apparent if the fundamentals which influence stability are understood.

The chief and most severe causes of transient instability are short-circuits; either a single or double line to ground, a line to line, or a three-phase fault. The most important means for minimizing the effect of such faults can be summarized under the following headings:

(1) by variation in machine design.
(2) by variation in system connections.
(3) by installation of equipment which will maintain line voltage or reduce the effective line reactance.
(4) by limitation of fault current.
(5) by speed control of synchronous machines.
(6) by quick removal or avoidance of short circuits.

### Effect of Machine Design

Three factors in the design of a synchronous machine which affect the transient stability limits are the transient reactance, the rotor inertia, and the damping effect of rotor windings.

An increase in rotor inertia will make it possible to clear the fault before the machine rotor has reached as great an angular displacement as it would with less inertia, or conversely, a longer time can be taken to clear the fault and give the same angular displacement. The benefit is limited, for the effect of increasing the inertia everywhere on the system by a given ratio is only equal to the effect gained by decreasing the fault clearing time by the square root of this ratio. Furthermore, this involves increasing the inertias of all machines on the system.

A reduction in the transient reactance of the synchronous machines may or may not produce an appreciable increase in transient stability limits depending upon the amount of external reactance, location of the short-circuit and the general system layout. In any event the gain will be small.

The effect of an amortisseur or damper winding is two-fold: first, an increase in fault current at the first instant with a correspondingly greater shock to the system and second, a damping action decreasing the time and magnitude of oscillatory rotor swings. In general it may be said that the beneficial effect of damping exceeds the detrimental effect of increased shock. For this and other reasons it appears desirable that water-wheel generators be equipped with damper windings of the proper design. The actual gain in transient stability limit will be small.

A salient-pole machine will have a slightly higher stability limit than a corresponding cylindrical rotor machine. However, this is largely a matter of facility in construction.

### Effect of System Connections

Faults near a bus or high-tension switching station which ties together the ends of several transmission circuits leading to major synchronous machine groups will generally give the system a more severe shock than faults at other, less centrally located points. Obviously such system "hubs" should be avoided whenever possible. In one practical case known to the author, transmission circuits emanating from several major generating groups were tied solidly together at a centrally located, high-tension bus.

A three-phase short on one of the circuits near this point resulted in a loss of synchronism between these major machine groups and the entire source of supply to an important load center was lost. Simply sectionalizing this bus and speeding up the switching time of one of these circuits made the system capable of withstanding a three-phase short circuit at any point on the system.

Examples of high-tension and low-tension bussing are shown in Figs. 6 and 10. Low-tension bussing reduces the severity of faults on the high-voltage circuits because of the increased reactance to the fault made possible by such an arrangement. The power that can be transferred during prolonged faults is therefore increased. On the other hand if the faulted circuit can be cleared very quickly, the low-tension bussing arrangement will have a higher transformer reactance between machines than would be the case if high-tension bussing were employed. Consequently when the switching times are long, the low-tension bus is advantageous, but with high-speed breaker and relay times, the high-tension bus is preferable. For average switching times of 0.2 seconds neither method has any particular advantage. However, as breaker and relay times are reduced, high-tension bussing merits consideration. One or more intermediate high-tension busses may prove advantageous when the system inertia is high and when the breaker and relay times are extremely rapid.

### Maintenance of Line Voltage or Reduction of Effective Line Reactance

The same amount of power can be transmitted over two high-voltage circuits as over a larger number at a lower voltage. As indicated in the discussion under steady-state stability, two 220 kv lines will have the same reactance as eight parallel 110 kv lines. However, switching out one faulted line will double the transfer reactance in the first case, while in the second case the increase will be only one-seventh. Because of this smaller increase in transfer reactance the larger number of low-voltage circuits will have the higher transient stability limit. If the same number of circuits are to be used at either voltage, the higher voltage system will have the higher stability limit because of its lower transfer reactance.

The use of synchronous condensers at intermediate points along a long line will increase the steady-state stability limit because of their supply of wattless current and improvement in line regulation. However, under transient conditions both experience and calculations have shown their effect upon the transient stability limit to be either negligible or unjustifiable because of cost.

Series capacitors have been proposed as a possible means for counteracting the line reactance. They will definitely improve transient and steady-state stability limits but cannot carry short-circuit current due to the voltage drop across them. As a result the capacitor on the shorted line must be cut out of service by a protective breaker. However, the unaffected lines will retain their low reactance. This proposal has great promise but cannot be seriously considered at the present time because of excessive cost.

Several years ago much consideration was given to the possible advantages of high-speed excitation. Thus, as soon as a fault occurred the excitations of all machines could be suddenly increased to a point where transient stability could be maintained. Returning again to the Constant Linkage Theorem, it requires an appreciable time for a severe system fault to produce a decay in machine fluxes. Correspondingly, it would require a more severe change in exciter voltage build-up to overcome this effect and actually increase the machine flux in a short time. Special exciters can be built to accomplish this to a certain extent and actual gains can be obtained. However, when the fault is cleared from the system serious overvoltages might result and circuit-breaker duty would be definitely increased. At the present time it is believed that exciters having "normal response" will tend to maintain constant flux-linkages and that any further steps in this direction are not desirable.

### Fault Current Limitation

Neutral reactors will limit the flow of ground current during faults involving grounds. They will not be effective in three-phase or line-to-line short circuits. For one line-to-ground faults the benefit is very great particularly for long switching times. Gains of lesser magnitude, but still considerable, can be obtained when the fault is two line-to-ground. Neutral reactors are usually placed between the transformer neutrals and ground. As the neutral reactance is increased, less gain is obtained and there is no advantage in going beyond two to three times the transformer reactance. The disadvantages of using neutral reactance are chiefly those due to ground relaying, the requirement for high insulation strength at the transformer neutral, and an increase in phase voltage to ground during disturbances. It must be remembered that neutral reactance has no effect on stability when the fault is three-phase or line-to-line. There appears to be no similar method for limiting fault currents not involving grounds since any reactance would have to be in series with the line and thus increase the transfer reactance.

### Speed Control

When a generator is delivering power to a motor and a fault occurs on one of the connecting circuits, there will be a sudden decrease in the power transfer between the two. If the mechanical power input to the generator and the mechanical power output from the motor remain constant, the generator rotor will speed up and the motor rotor will slow down. Any means whereby these speed changes could be minimized or avoided during the period before the fault is cleared would be effective in increasing the transient stability limit. The only apparent method for preventing the motor from slowing down would be to suddenly decrease its mechanical load the required amount. This would seldom be practical on large systems. The generator, however, could have its mechanical power input decreased by suitable governor control or its rotor could be artificially loaded by some means. Such artificial brakes or loads can be applied directly to the generator terminals in times of disturbance in the form of a three-phase bank of resistance. An alternative would be to use neutral resistors in the transformer neutrals, but these would be effective for ground faults only. A third possibility is to equip the generator with a high-resistance amortisseur.

When the motor inertia is large with respect to that of the generator, considerable gains could be obtained by any of these methods. The braking resistor, however, would require very rapid switching in and out at the proper times, high resistance amortisseurs may overheat because of any load unbalance under normal conditions, and neither the amortisseur nor the neutral resistor would be of any benefit for three-phase faults against which most systems must be protected.

The governor control and braking resistor methods appear to offer the best possibilities and in all probability one or

both of these means may receive consideration.

### The Quick Removal or Avoidance of Short Circuits

Perhaps the most obvious and certainly the most effective means for increasing transient stability limits are to first, avoid the occurrence of faults, and second, should this be impossible, to remove the short-circuit as quickly as possible. Much progress has been made in the design of insulation and in the protection of overhead circuits from lightning discharges. Efforts are also made to prevent faults from involving all three phases. However, it is impossible to avoid insulation failures entirely, and in most cases it is necessary to assume that three-phase short-circuits may occur.

The longer a fault is allowed to remain on the system, the greater the angle of displacement between the machine rotors will become, thereby decreasing the transient stability limit. In Table I are shown the approximate degree to which the various transient stability aids are effective. The per cent gains are roughly approximate but are representative for typical systems. Special cases may occasionally arise where the relative merits of the various means may be reversed and some may prove detrimental. In general, though, it may be concluded that the most effective means for improving transient stability is by the installation of adequate relaying and switching equipment together with a well-balanced system design.

TABLE I—RELATIVE EFFECTIVENESS OF VARIOUS MEANS FOR INCREASING TRANSIENT STABILITY LIMITS WHEN APPLIED TO TYPICAL SYSTEMS OF AVERAGE DESIGN AND PROTECTION

| | % Increase in Transient Stability Limit |
|---|---|
| 1. Low-voltage bus vs. high-voltage bus (two long lines) | 0% |
| 2. Increase due to braking effect of a high resistance amortisseur (line-to-line fault) | 3% |
| 3. Reducing transient reactance of all synchronous machines 30% | 5% |
| 4. Increasing inertia of all machines 30% | 8% |
| 5. Effect of series or shunt braking resistors (three-phase fault) | 15% |
| 6. Effect of neutral reactor equal to 300% of transformer reactance (two line-to-ground fault) | 20% |
| 7. Gain due to decreasing switching time from 0.4 seconds to 0.2 seconds | 40% |

Note: The above percentages are based upon relatively few sample calculations. It is felt that they are representative for average, typical conditions in so far as comparison between their relative effectiveness is concerned.

## Appendices to Mr. Waring's Paper

### APPENDIX A

**Derivation of the Steady-State Power-Angle Characteristic of a Salient-Pole Synchronous Machine**

Referring to Fig. 1a:

$$P = E_T\, i \cos\theta$$

$$\begin{aligned}\sin(\delta+\theta) &= \sin\delta\cos\theta + \cos\delta\sin\theta \\ \cos(\delta+\theta) &= \cos\delta\cos\theta - \sin\delta\sin\theta\end{aligned} \qquad \text{(A-1)}$$

Therefore:

$$\sin(\delta+\theta)\sin\delta + \cos(\delta+\theta)\cos\delta = \cos\theta \qquad \text{(A-2)}$$

However:

$$\begin{aligned}\sin(\delta+\theta) &= i_d/i \\ \cos(\delta+\theta) &= i_q/i \\ \sin\delta &= E_q/E_T \\ \cos\delta &= Ed/E_T\end{aligned}$$

Substituting these values in equation (A-2):

$$\cos\theta = \frac{i_d E_q + i_q E_d}{i E_T}$$

Therefore:

$$P = E_T\, i\cos\theta = i_d E_q + i_q E_d \qquad \text{(A-3)}$$

Also from Fig. 1a:

$$i_d = \frac{E_l - E_d}{x_d}$$

$$i_q = \frac{E_q}{x_q}$$

$$E_d = E_T\cos\delta$$

$$E_q = E_T\sin\delta$$

Substituting these relations in equation (A-3) and simplifying, the following equation is obtained:

$$P = \frac{E_l E_T}{x_d}\sin\delta + E_T^2\frac{(x_d - x_q)}{2\,x_d\,x_q}\sin 2\delta \qquad \text{(A-4)}$$

### APPENDIX B

**Derivation of the Transient Power-Angle Characteristic of a Cylindrical-Rotor Synchronous Machine**

Referring to Fig. 8:

$$P = E_T\, i_2\cos\theta \qquad \text{(B-1)}$$

But:

$$i_2(x'_d + x'_e)\cos\theta = E'\sin\beta$$

Or:

$$i_2\cos\theta - \frac{E'}{x'_d + x'_e}\sin\beta \qquad \text{(B-2)}$$

Substituting equation (B-2) into equation (B-1):

$$P = \frac{E'\,E_T}{x'_d + x'_e}\sin\beta \qquad \text{(B-3)}$$

## Recent Publications

(*Continued from page* 451)

of papers, symbols and conventions reproduced in this report have been worked out in order to:

1. Simplify wiring diagrams.
2. Make comparisons of different methods easier.
3. Facilitate checking of diagrams and connections.

It is recommended that these conventions be used by manufacturers, utilities and others in all manuscripts prepared for publication, and in all other meter work wherever possible.

### METHODS OF MEASURING RADIO NOISE

E.E.I. Pub. C-9. A report of the Joint Coordination Committee on Radio Reception of Edison Electric Institute, National Electrical Manufacturers Association and Rado Manufacturers Association, 5 pages Price 15c. to members and their employees; 35c. to nonmembers in the U. S. A.; 45c. to foreign countries.

This report contains specifications for instrument for measuring radio noise and procedure to follow in use of instrument.

## LCODE

THERE are still some utility companies who have not yet provided themselves with copies of LCODE. This telegraph code was published expressly for the electrical industry in the interests of economy.

Expert analyses made by users prove that LCODE reduces telegraph expenses 31 per cent. For this reason more than 400 individual companies have purchased over 4000 copies; many of them having equipped all their offices with copies on account of its proved efficiency and economy.

Several operating companies find LCODE very useful when telegraphing statistical data to the Institute or their head office; holding companies also find LCODE the most economical way

(*Continued on page* 484)

# Lowering a Half Mile of Electrical Conduits by Means of Ice

EARLY in 1935, the Bureau of Highways, Office of the Borough President of Brooklyn, gave notice that for drainage purposes the level of Flatbush Avenue would be lowered approximately three feet for a distance of about one-half a mile in front of Floyd Bennett Airport. The Brooklyn Edison Company was maintaining an underground duct line in the roadway and this project of the Borough authorities made it necessary to lower the conduit the same amount that the road was to be lowered.

The duct line consisted of eight four-inch fibre pipes encased in concrete, and it contained cable feeders which could not be taken out of service without the installation of bypass feeders. The cost of installing these bypasses, breaking out the duct line and then reconstructing the duct line at the lower elevation was estimated at nearly $90,000.

At this point, it was suggested that if cakes of ice were placed at suitable intervals under the duct line and the supporting earth removed, the melting ice would lower the structure as a unit without inducing any great stresses in the concrete.

The New York Telephone Company was, at this time, experimenting along these lines with their own conduit in a similar case, but due to the greater weight and to the concrete casement on our conduit we could not accept their data without some additional information, so numerous blocks of ice were tested and it was found that a normal surface pressure of 75 pounds per square inch caused the ice to fail in shear along a plane at 45 degrees to the normal. The above figure is a low average value because it was obtained using commercial cakes of ice with their usual imperfections.

The duct line and cables weighed 250 pounds per foot and to avoid abnormal stresses in the line it was decided that these ice supports would be necessary at six-foot intervals. The weight on each ice support was 1500 pounds, and if a normal stress of 40 pounds per square inch was allowable, a section of 37.5 square inches for bearing surface of the ice was the minimum.

Commercial cakes of ice come with the dimensions of 14 x 30 x 48 inches and it was decided to cut these cakes in half, thus making a 24-inch supporting block for the duct line, and a bearing surface of 420 square inches. This bearing area reduced as the ice melted.

This method was tried on a section of the duct line about 300 feet in length and worked so well that the remainder of the structure was lowered in the same manner, taking the sections between manholes which averaged from 300 to 500 feet.

The actual work was done as follows:

1—The section of duct line was exposed for its entire length and cut loose from the end manholes.

2—Holes large enough to contain the blocks of ice were dug under the line at 6 foot intervals.

3—The ice was then placed under the duct line and shimmed up to give support.

4—The remainder of the earth was then removed and the line left entirely supported on the ice blocks.

The sectional area of the ice was preserved as much as possible by piling the earth around the block for insulation. The ice, in melting, assumed the shape of a truncated pyramid with the smaller base in contact with the duct. The line was kept under constant inspection and was braced where necessary to prevent lateral tilting.

It generally required about 72 hours for the ice to melt down to a sectional area approaching the minimum and in this time the duct line itself had been lowered about 19 inches. Where more lowering was needed the process was repeated.

The total saving in the amount of labor and material proved to be better than 60 per cent as compared with the estimated labor and material required in the breaking out and reconstructing method.

*Duct line exposed and excavated to receive the blocks of ice*

# P. H. Gadsden Awarded Bodine Medal

PHILIP H. GADSDEN, Vice-President of the United Gas Improvement Company, has been presented with the Samuel T. Bodine Meritorious Award, in recognition of his work as Chairman of the Committee of Public Utility Executives.

The Award, established in 1925 by the U.G.I., was made at a meeting of the Board of Directors of the United Gas Improvement Company on October 22. Members of the U.G.I. staff were also present to honor Mr. Gadsden. President John E. Zimmermann presented the Award, a handsome medal and certificate, and read the citation upon which the Award to Mr. Gadsden is based. Mr. Gadsden's work, which won his company's highest honor, is described in the citation as follows:

"Early in February of this year the Committee of Public Utility Executives, of which you are chairman, was organized for the protection of the interests of the millions of consumers, workers, and security owners of the industry, as a result of the introduction in the Congress of the United States of the so-called Wheeler-Rayburn Bill. From that date until August 26, when the President of the United States signed the Public Utility Act of 1935, you were the courageous and able leader in the defense of liberty and right.

"Tactful and patient you maintained throughout, the wholehearted cooperation of the utility executives of the country, representing as they do diverse interests and problems.

"Insistent in your demand that full opportunity be given the industry to be heard, you secured from the House Committee on Interstate and Foreign Commerce adequate hearings for the presentation of testimony of the accomplishments of the holding companies and the contribution of the industry to the development of the nation.

"A fighter, but a fighter with a high concept of ethics and an unwavering fidelity to clean and above-board methods. You fought no defensive rear guard action. Backed by a devoted army you not only stood your ground, but fearlessly and with vigor attacked with the truth every unfair statement or inference from those bent on the destruction of the interests you represented.

"Throughout this trying period you consistently exercised clear wisdom, sound judgment, and forceful leadership, characteristics which had caused the utility executives of the country to unanimously select you to guide them through the greatest crisis the industry has ever faced."

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# Low Resistance Grounds

ENGINEERING Report No. 31* of the Joint Subcommittee on Development and Research, which presents information on the installation and measurement of grounds, has recently been released for general distribution. The data on which this report is based have been collected from a number of locations in the United States and Canada, and from various sources. Much of the information was obtained during the installation of grounds for relay protectors along telephone lines. These grounds were in the order of 1 to 5 ohms resistance, and for the most part consisting of driven rods connected in multiple. In a number of instances opportunity was afforded for the study of these ground structures during the process of their installation, thus providing information on the effect of adding parallel rods and the effect of rod spacing upon the efficiency of paralleling. In this connection it was observed that the efficiency of paralleling depended to a considerable extent upon the type of soil.

The report discusses the general classifications of soil with respect to their desirability for production of low resistance grounds. Where there is some choice as to the location of a particular ground some hints are given regarding the location of the ground and simple tests are suggested which will indicate the relative desirability of the various available locations. However, it has not been found possible to predetermine the number of ground rods or the extent of the grounding system which will be necessary to secure a ground of a particular resistance.

Data are given concerning chemical treatment of soils to reduce the resistance of grounds. Several chemicals have been used with success and the method of application is discussed. The variation of the resistance of chemically treated and untreated grounds with time are given in the form of curves for several grounds in different parts of the country, and cover periods of observation up to six years. These curves also show the variation in resistance with the season of the year.

Most of the grounds mentioned in the report consisted of 5 or 8 ft. driven rods connected in parallel, although there are some data on long driven rods in the order of 30 ft. The majority of the ground structures were designed to carry 60 cycle current. However, included in the report are measurements on grounds at frequencies up to 80 kilocycles.

Another section of the report discusses various methods of measuring grounds and reviews the various types of apparatus available for such measurements. With high resistance grounds or structures of small extent the measurement of ground resistance is quite simple. However, unless special precautions are taken serious errors may be introduced in measuring grounds which are of low resistance and large extent. The precautions necessary for such measurements, and the application of methods of measuring grounds to such situations are considered.

* Price $.40 to members, $1 to non-members.

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## LCODE

(*Continued from page* 482)

of sending and receiving telegraphic reports from the field regarding maintenance of equipment, etc. As all the large electrical manufacturers have copies, direct communication between them and the field can be carried on at minimum cost when LCODE is used.

The price is $6.50 a copy less 10 per cent discount to members of the Edison Electrical Institute. Members would do well to have a copy on hand. Orders may be sent direct to this headquarters or to the publishers, The Business Code Co., Inc., 330 West 42nd Street, New York, N. Y.

# Fall Meeting of the Joint Subcommittee on Development and Research

THE Joint Subcommittee on Development and Research met with its project committees in the offices of the American Telephone and Telegraph Company on December 12 with Mr. Warren, the Bell System Chairman, presiding. The morning session was devoted to the work of Project Committees 2A, 2C and 2G, on structural coordination problems. The afternoon session covered the noise induction studies of Project Committees 1A, 1B and 1C, and the low frequency studies of Project Committees 2D, 2J and 2K. Each of the project committees presented a progress report covering its work during the last six months. In addition, eight technical reports were presented.

*Project 2A—Hazard and Protection* presented, for the information of the Joint Development and Research Subcommittee, a Technical Report, entitled "Study of Joint Use Situation in Wichita, Kansas." This report describes the physical layout of the telephone plant and also the present 4-kv and proposed 12-kv power distribution systems in the city of Wichita, Kansas. Estimates of maximum voltage and current conditions resulting from contacts with aerial cable and open wire lines are given for several different 12-kv systems. The possible effects of contacts with different types of telephone plant under these conditions are described along with possible means of minimizing these effects. Means for providing satisfactory safety with the various systems are described.

This project committee also presented a preliminary draft of a Technical Report giving the results of its study of safety for joint use of poles by telephone circuits and power supply circuits in the 6600 and 13,200 volt class. The project committee stated that this report is not yet in form for action by the Joint Subcommittee, but that they were presenting it at the meeting in order to secure the benefit of more general discussion.

*Project Committee 2C—Joint Use Economics* presented, for the information of the Joint Development and Research Subcommittee, a Technical Report, entitled "Akron Joint Use Study." This report describes a study of the economics, relative safety and noise considerations involved in power and telephone distribution with and without joint use with primary circuits in suburban and rural sections in the Akron, Ohio, area. The essential features of the power and telephone systems involved and the local physical conditions are described. Various plans of distribution are discussed and the relative economics of power and telephone plant are given for each plan. Estimated fault currents and potentials resulting from contact under various conditions are given. The relative hazards and noise considerations are discussed and certain means for improvement in safety conditions are indicated.

*Project Committee 1A—Noise Induction* brought up for discussion the preliminary draft of a report on the use of power and telephone transpositions within exposure sections. The project committee stated they were bringing the report up at this time to obtain the benefit of the comments of members of other project committees interested, and that subsequent to the meeting the report will be revised and resubmitted to the Joint Subcommittee.

*Project Committee 1C—Wave Shape* presented a Technical Report, entitled "Selective Devices for Reducing Harmonics on Power Systems—Part II A-C Systems." This report describes and discusses the design and application of a number of different types of frequency selective devices suitable for reducing harmonic components in a-c systems. It is a companion report to Engineering Report No. 21, which discussed similar devices applicable in d-c systems. In connection with the application of these selective devices to a-c systems the report points out that:

1. Resonant shunts used either individually or in combinations of two or more in parallel afford the most generally practicable type of selective device for reducing either the slot harmonic components arising in synchronous machinery or the harmonics occurring in the a-c supply circuit to a rectifier.

2. Under certain circumstances, limited amounts of series inductance and shunt capacitance may be used advantageously in combination with resonant shunts.

3. The low pass type of filter consisting of series inductance and shunt capacitance has a limited field of usefulness in the a-c supply circuit to rectifiers supplying a relatively constant load.

The discussion of the design formulas and of the application of the various selective devices is supplemented by an appendix which presents illustrative examples demonstrating the use of the formulas and comparing results obtained by calculation with test data obtained in the field. The derivation of the design formulas is covered in a second appendix. The Project Committee recommended this report for issuance as an Engineering Report.

This Project Committee also presented a Technical Report, entitled "The Telephone Influence Factor of Supply System Voltages and Currents." For a number of years there has been used in the field of inductive coordination a factor known as the Telephone Interference Factor, abbreviated T.I.F., for evaluating the wave shape of power system voltages and currents in terms of their inductive influence on exposed telephone circuits. As a result of recent studies of the relative interfering effects of single-frequency noises in telephone circuits, the T.I.F. frequency weighting characteristic has been revised. In connection with this revision the name has been changed to Telephone Influence Factor. This report discusses the significance of the Telephone Influence Factor, and describes the revised frequency weighting characteristic and its derivation. The correlation to be expected between readings obtained using the old and new weightings is discussed. Reference is made to the application of T.I.F. to both balanced and residual power system voltages and currents, and to the open-circuit voltage of machines. A brief description is included of methods of measuring T.I.F. and of the method of calculating this quantity from a harmonic analysis. Prior to this meeting this report had been approved by the Plant Coordination Committee by letter ballot as Engineering Report No. 33*.

*Available to members of the Edison Electric Institute at a price of 40¢, and to non-members at a price of $1.00.

*Project Committee 2D—Specific Devices* presented a Technical Report, entitled "Unit Type Relay Protector." Information is presented in this report concerning a short-circuiting relay protector for use on a single pair of wires. The purpose of its development was to provide a device which would minimize for certain types of induced voltages the permanent grounding of protectors at central offices and at other points where such troubles are likely to cause an undue amount of lost circuit time. Laboratory tests and trial installations which have been in progress over the past year and a half have indicated that the device will be suitable for these purposes. The tests and trials are summarized in the report and descriptions are given of the mechanical and electrical features of the protector, together with the method of installation used in these trials. The Project Committee recommended this report for issuance as a Provisional Report.

*Project Committee 2J—Control of Residuals* presented a Technical Report, entitled "Study of Observations from Low Frequency Induction Exposures." This report presents an analysis of data relative to low-frequency induction due to power system ground-fault currents, obtained from oscillographic observations and related records from 29 inductive exposures. Data as to the magnitude and magnitude distribution of observed voltages and their comparison with estimated values are presented, together with available data as to the effects of such voltages. For the purpose of applying, to other situations, the data on the magnitude distribution, (the proportion of records of induced voltage which may be expected to exceed a particular percentage of the maximum value) average curves based on the observations have been prepared. In addition a theoretical method of deriving magnitude distribution curves is presented and its use illustrated. The information in the report is intended as an aid in the appraisal of low-frequency inductive coordination problems. The Project Committee recommended this report for issuance as an Engineering Report.

Announcement will be made in the E.E.I. Bulletin when reports recommended for issuance as Engineering Reports, or Provisional Reports are approved by the Joint Committee on Plant Coordination.

# Lamp Sales Campaign Brings Customers to Dealers

A RECENT Mazda lamp campaign sponsored by the Nebraska Power Company in Omaha departed from the usual theme of bringing lamp salesmen (or saleswomen) into the homes, the campaign brought homemakers to the dealers, giving the latter opportunity to sell additional merchandise.

This lamp activity resulted from the recent price reduction of Mazda lamps and was designed to reduce the dealer's overhead expense to a minimum.

Here are the details of the six-week campaign that closed Nov. 9. Each dealer prepared a Mazda lamp display in his store. Customers guessed the number of lamps in a container each week, the winner receiving an I.E.S. study lamp as a prize. Chances on the guessing contest were given with each purchase of a carton of lamps.

The main expense item for the dealer was $1.50 a week, a portion of the cost of the prize lamps. Remainder of the cost was paid by the Nebraska Power Company, which furnished all material for the activity, including advertising—billboard, newspaper, tabloids to every home in the city, bill enclosures and radio announcements. Each dealer was provided with 100 handbills bearing his name and address and the price of the lamps. Also window streamers, floor and window cards, display card for prize lamp, contest coupons and box for depositing coupons were provided by Nebraska Power Company.

An attractive six-page folder listing the entire plan of the 1935 Omaha Dealer Mazda Lamp activity was printed and distributed to the 57 dealers who entered the campaign.

Majority of sales were cash. Dealers who desired could make charges and have them carried on the customer's electric service account by the Nebraska Power Company. If he desired, the dealer was also allowed to hire bulb salesmen (house-to-house) and have these sales, when charged, turned in to the Nebraska Power Company for billing.

Each dealer recorded his sales, turning in a report to the power company each week before receiving his prize lamp for the following week. A quota of 100,000 lamps, average 60 watts per lamp, was set. The result of 104,394 lamps sold, average 55.9 watts, was regarded highly successful.

**Results of the Campaign:**

| | |
|---|---|
| Prize lamps awarded | 243 |
| Total lamps sold | 104,394 |
| Average wattage of lamps sold | 55.9 |
| Volume of sales in dollars | $18,572 |
| Lamps sold per meter | 2 |
| Dealers in campaign | 57 |
| Number of dealers employing outside salesmen and charging sales | 5 |
| Per cent of cash sales | 90 |

# Power Sales Problems

(*Continued from page* 458)

Five billion dollars is a potent lever for improvement until it has to be paid back. Then it will work the other way.

The South is being impoverished by the destruction of the foreign market for their cotton. The West has lost its meat and wheat market. The industrials are facing foreign competition. Under such conditions there can be no genuine, permanent, sound business development. Yet, the present upthrust may reach a high level and hold for a few months, possibly for a year, depending upon how long pay-day is deferred.

Consequently, all present indications seem to show that the trend of performance which has been attained so far this year will be maintained at least for the balance of the year. With the adjournment of Congress, business has been afforded a breathing spell free from additional threats and impositions which may provide some additional stimulus to the present performance.

Let us make sure that we are developing equally the various phases of our business. Let us know and meet the problems presently surrounding industrial power sales. Let us do nothing, in order to gain a temporary advantage with some other class of business, that will tend to harm their development. I am sure that in these directions lie the best interests of the public, the investors, utility employees and the utilities themselves.

# POWER SALES ITEMS

## AIR CONDITIONING

"Air Conditioned Enameling Plant." *Ceramic Industry,* November, 1935, p. 282. Industrial Publications, Inc., 59 East Van Buren Street, Chicago, Ill.

Controlled atmosphere for graining and printing departments results in better quality work and higher output.

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"Cooling for Comfort," by R. B. Purdy, Associate Editor, *Power,* October, 1935, p. 530. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

Ninth of a series of articles on air conditioning. This article shows what takes the heat away in the cooling plant.

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"Will Air Conditioning Become a Desirable Electrical Load?" by R. E. Powers. *Electrical Journal,* November, 1935, p. 531. Electric Journal, Publishers, 530 Fernando Street, Pittsburgh, Pa.

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"Air Conditioning Boosts Recreation Establishment." *Electric Refrigerating News,* October 30, 1935, p. 13. Electric Refrigerating News, Publishers, 550 Maccabees Building, Detroit, Mich.

Air conditioning eliminates seasonal slumps in bowling and billiards and increases patronage.

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"Air Conditioning for Small Hotels." *Hotel Monthly,* March, 1935, p. 23. John Willy, Inc., Publishers, 950 Merchandise Mart, Chicago, Ill.

An economical air conditioning system for a small hotel which resulted in a fifty per cent increase in business described.

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## DIESEL ENGINES

"Indicator Diagrams — Diesel Engine." *Power,* October, 1935, p. 546. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

Data sheet showing twenty-one diagrams giving corresponding indicator and engine troubles.

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"Cambridge Instrument Company Operates Diesel Plant." *Diesel Power,* November, 1935, p. 700. Diesel Publications, Inc., 192 Lexington Avenue, New York City.

A small article describing the Diesel unit which saved money for the famous cardiograph plant.

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"Colony Club Installs Diesel Plant and Starts Making Money," by H. E. Hill. *Diesel Power,* November, 1935, p. 708. Diesel Publications, Inc., 192 Lexington Avenue, New York City.

Describes the Diesel installation at the Colony Club, New York City, which reduced their power cost 71 per cent. Comparative figures are given.

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## ELECTRIC DRIVES

"Variable-Voltage Drive Boosts Gold Dredge Output," by Charles Stoeckly, *Electrical World,* Oct. 12, 1935, p. 24. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

The author describes equipment used on a fully electrified 500 cu. yd. per hour river-bottom dredge which resulted in improved power factor, reduced power consumption and increased production.

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"Rubber Industry Electric Drives." *Brown Boveri Review,* November, 1935, p. 218. Brown Boveri & Company, Ltd., Publishers, 19 Rector Street, New York City.

Characteristics of motors to drive the different classes of equipment, with their methods of operation.

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"The Application of Electric Power to the Rubber Industry," by D. D. Rayner. *World Power,* November, 1935, p. 224. World Power, Publishers, 62 Lincoln's Inn Fields, London, W. C. 2.

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## ELECTRIC FURNACES

"Resistance Furnace Capacitors Cut Costs," by W. H. Austry. *Electrical World,* Nov. 9, 1935, pp. 32-33. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

The use of capacitors for power factor correction on resistance furnaces is unusual because pure resistance loads have unity power factor. However, on large resistance furnaces at low voltages the inductance of the low voltage connections reduces the power factor. This article deals with a condition where the power factor was found to be 70 per cent, and capacitors are used for correcting this condition.

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"Electric Furnaces for Ford Plant." *Blast Furnace and Steel Plant,* November, 1935, p. 785. Steel Publications, Inc., 108 Smithfield Street, Pittsburgh, Pa.

Bell-type electric furnaces to be used for bright-annealing steel strip.

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## ELECTRON TUBES

"More Jobs for Electron Tubes," by L. R. Harness. *Factory Management and Maintenance,* November, 1935, p. 476. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

Butcher, baker, and candlestick maker are using them in many ways to give services needed to keep production flowing smoothly.

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## FUELS

"Down to 0.8 lb. per Kilowatt-Hour." *Electrical World,* Oct. 12, 1935, p. 80. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

An article comparing fuel rates for coal, oil and gas in public utility power plants.

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## GAS ENGINES

"Engines—Operation and Maintenance," by B. L. Rogers. *Power Plant Engineering,* November, 1935, p. 623. Technical Publishing Company, 53 West Jackson Blvd., Chicago, Ill.

Experience in operating compressor station prime movers told to the National Gas Department of the A. G. A.

## PAPER MILLS

"Utilizing Wood Bark." *Industrial Bulletin of A. D. Little, Inc.,* November, 1935, p. 4. Arthur D. Little, Inc., Publishers, Cambridge, Mass.

Paper mill has developed a use for waste bark piles which will use considerable electricity in processing.

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## POWER FACTOR

"Correcting Power-Factor with a Phase-Advancer," by L. A. Hunt. *Electrical News and Engineering,* Nov. 15, 1935, p. 26. Hugh C. MacLean Publications, Ltd., 347 Adelaide Street, West, Toronto 2, Ontario, Canada.

Recent installation in Canada Packers, Ltd., Toronto, improved power-factor from 73 to 93 per cent.

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## PURCHASED STEAM

"Steam Line Connects Public Utility and Paper Mill." *Paper Trade Journal,* Nov. 22, 1934, p. 39. Lockwood Trade Journal Company, Inc., Publishers, 15 West 47th Street, New York City.

Fourteen-inch line supplies up to 150,000 pounds of steam per hour to paper mill.

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## RESTAURANTS, ELECTRIC

"All Electric Restaurant Prospers," by J. P. Schaefer, Potomac Electric Power Company. *Electric Light and Power,* November, 1935, pp. 20-21. Bennett-Watts-Haywood Company, Publishers, 360 North Michigan Avenue, Chicago, Ill.

An article about the new all-electric S. & W. Cafeteria at Washington describing the costs and results obtained from the generous use of good lighting, electric cooking and air conditioning.

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## REVERSED REFRIGERATION

"Using the Reversed Cycle Refrigerating Principle for a Self-Contained Heating and Cooling Unit," by H. L. Galson. *Heating, Piping and Air Conditioning,* October, 1935, p. 497. Keeney Publishing Company, 6 North Michigan Avenue, Chicago, Ill.

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## STEAM POWER PLANTS

"Annapolis Modernizes Power Plant." *Power Plant Engineering,* November, 1935, p. 626. Technical Publishing Company, 53 West Jackson Blvd., Chicago, Ill.

United States Naval Academy replaces old boilers with new ones and installs a. c. generating equipment.

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## STEEL MILLS

"Alternating Current for Pickling." *Electrical Production,* October, 1935, p. 10. Electrical League of Cleveland, Inc., Publishers, Builders' Exchange Building, Cleveland, Ohio.

How the Ferrolite system operates for pickling steel.

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## TEXTILE PLANTS

"Textile Plant Power Costs." *Link-Belt News,* October, 1935, p. 6. Link-Belt Company, Publishers, 910 South Michigan Avenue, Chicago, Ill.

The cost of private and purchased power compared for a plant which installed its own power plant.

## NOT EXACTLY A LAMB

*An editorial from the New York Sun, Nov. 27*

There is no answer which in common sense or in logic can be made to the argument of WENDELL L. WILLKIE of the Commonwealth and Southern Corporation setting forth why holding companies in the utility field should refuse to register under the holding company act. He thrust aside the sham and hypocrisy which have been employed to conceal the real purpose of this legislation when he said:

> It has been indicated that by refusing to register the corporation may incur the ill will of the Federal Administration and its various agencies and legislative committees. The almost unbelievably unfair attack on this industry by the governmental agencies and officials who are also sponsoring the heavily subsidized Tennessee Valley Authority program, and who are spurring municipalities by outright gifts of 45 per cent of the cost of distribution systems to duplicate and compete with our systems, leaves us little hope that we could obtain the good will of these governmental agencies, no matter what course we took with reference to registration.

These are words spoken on behalf of an industry which knows that it is fighting for its life. The real goal of the opposition is not regulation of the electric utility business but its replacement by public ownership. The strategy is plain: first, all the powerful management corporations are to be broken up so as to deprive operating companies of the advantages of central financing and direction; then operating companies are to be "integrated" into small territorial subdivisions; after that they will be destroyed piecemeal through ruinous competition with municipal and district public ownership units in which operating deficits will be made up by the taxpayer. After private concerns have been driven out of the field, the various public ownership groups doubtless will be "integrated" again into a Federal system managed by bureaucrats in Washington.

The private utility business is wise in deciding that since it must fight it will fight all the way. It has strong reason for believing the holding company act unconstitutional. The bleating of the lamb traditionally annoys the tiger; if the private utility business has decided not to play the rôle of lamb, what fair-minded American can blame it?

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## CONVENTIONS AND MEETINGS

**DECEMBER**

2-6 American Society of Mechanical Engineers, New York, N. Y.

18 Insurance Committee, Astor Hotel, New York, N. Y.

**JANUARY, 1936**

9-11 American Engineering Council, Washington, D. C.

28-31 American Institute of Electrical Engineers, New York, N. Y.

**FEBRUARY**

10-11 Electrical Equipment Committee, Statler Hotel, Buffalo, N. Y.

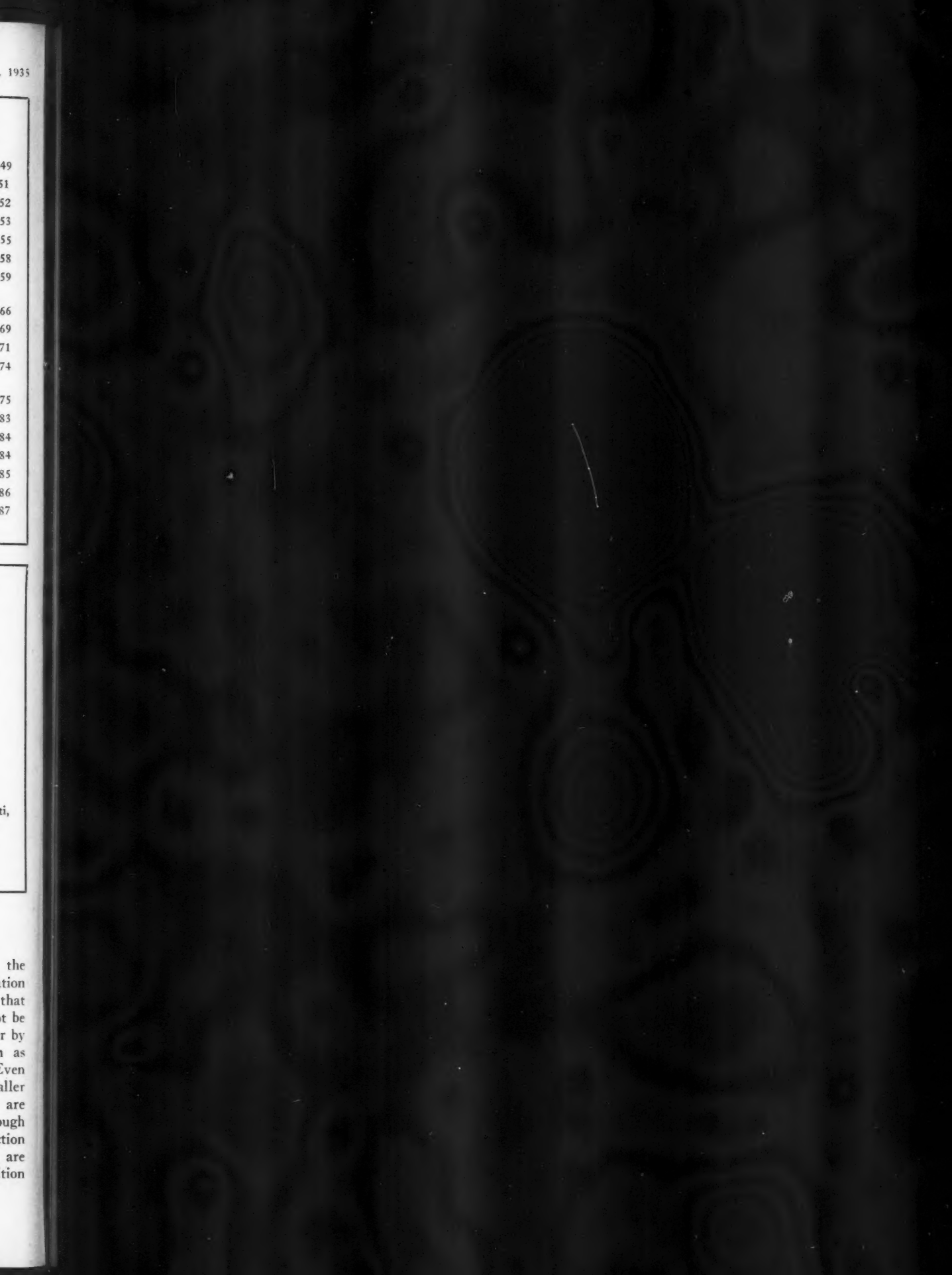
13-14 Transmission and Distribution Committee, Netherlands Plaza Hotel, Cincinnati, Ohio.

**JUNE**

17-20 The American Society of Mechanical Engineers, Dallas, Texas.

## Low Voltage Fatalities

(*Continued from page* 452)

be foreseen. The majority of all cases therefore are matters where education provides the only sound remedy. Thus the well-known group of cases involving worn and abraded cords can be reduced only by persuading people of the necessity for renewing cords when they become worn, since the best of cords will ultimately reach a dangerous condition.

This brief note upon a subject which might be discussed at great length is presented at this time for the reason indicated at the beginning of this article, namely, that there appears to be current a fantastically exaggerated idea of the extent of this hazard and of its relation to wiring and because it is believed that the abatement of the hazard will not be promoted by exaggeration, but rather by a sound appraisal of the situation as nearly as it can be determined. Even though the total numbers may be smaller than some may have believed, they are still too large, and amply great enough to justify the best efforts for reduction that can be applied by those who are close to the problem and in a position to apply effective remedies.